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# **Antimicrobial Resistance Testing: Public Health Laboratory Testing Updates, and Recommendations for Isolate Submission and Reporting**

**California Antimicrobial Resistance Lab-Epi Alliance**

**October 6, 2021**

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**California Department of Public Health  
Microbial Diseases Laboratory (MDL) and  
Healthcare-Associated Infections (HAI) Program**

# Objectives

- Summarize 2019-2021 MDL carbapenemase testing, *Candida* species confirmation testing, and whole genome sequencing (WGS) results.
  - Provide updates on MDL and regional AR Lab Network testing capabilities for *Candida* and carbapenem-resistant organisms.
  - Summarize AR testing capabilities of clinical laboratories reported via the National Healthcare Safety Network (NHSN).
  - Present HAI AR case and cluster investigation data, including for recent multi-jurisdictional outbreaks.
  - Review public health recommendations for AR isolate submission and reporting by laboratories, including proposed Title 17 changes.
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# Emerging Antimicrobial Resistance (AR) Threats

- Bacteria and fungi resistant to many or all antimicrobials tested
  - Few treatment options, higher morbidity and mortality
  - Uncommon in geographic area or the U.S.
  - Highly transmissible within and between healthcare facilities, cause outbreaks
  - Early and aggressive containment can limit spread
  - Examples include *Candida auris*, carbapenemase-producing organisms
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## *Candida auris*

- Multidrug-resistant yeast
  - 90% fluconazole
  - 30% amphotericin B
  - <5% echinocandins
  - Can be resistant to all 3 antifungal classes
- Difficult to identify with standard lab methods
- Easily transmissible in the healthcare environment
- Can cause serious, invasive infections with 30-60% mortality



# Carbapenem-resistant Organisms (CRO)

- **Carbapenems** are “last resort” antibiotics (doripenem, ertapenem, imipenem, meropenem)
  - **Carbapenem-resistant organisms (CRO)** include:
    - Enterobacterales (**CRE**), e.g., *E. coli*, *Klebsiella* species
    - *Pseudomonas aeruginosa* (**CRPA**)
    - *Acinetobacter baumannii* (**CRAB**)
  - **Carbapenemase** enzymes are primary mechanism for carbapenem resistance; **CRO produce carbapenemases**, which inactivate carbapenems, other  $\beta$ -lactam antibiotics.
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# Carbapenemase-producing Organisms (CPO)

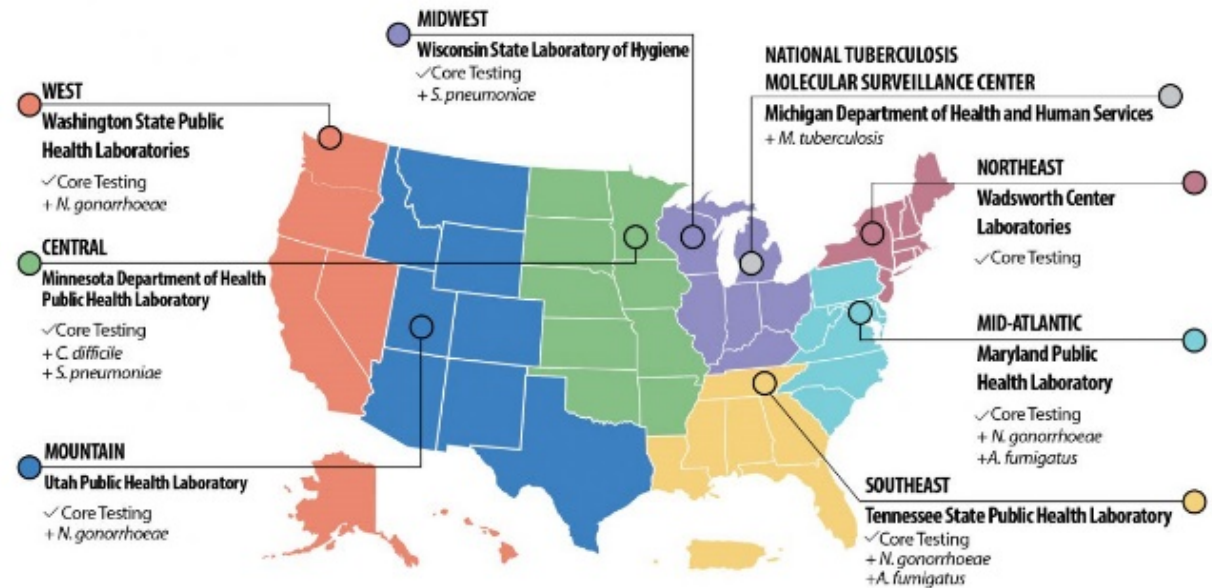
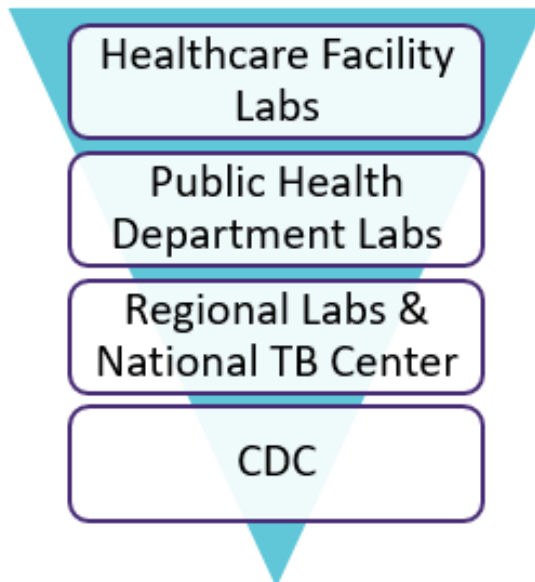
- **Carbapenemases** include:
  - **KPC, NDM, IMP, VIM, OXA** (e.g., OXA-48-like, OXA-23-like)
- Many **carbapenemase genes** are on mobile genetic elements (plasmids), and can “jump” between/within species
  - E.g., NDM-producing *E. coli* → NDM-producing *A. baumannii*
- **Carbapenemase testing methods:**
  - **Phenotypic** tests for carbapenemase production
  - **Molecular/Genotypic** tests detect specific carbapenemase gene

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KPC=*Klebsiella pneumoniae* carbapenemase; NDM=New Delhi metallo-beta-lactamase;  
IMP=Imipenemase; VIM=Verona integron-encoded metallo-beta-lactamase; OXA=Oxacillinase

# Antibiotic Resistance (AR) Lab Network

- Supports nationwide lab capacity for emerging AR pathogens
- Early detection to enable timely response



CS316981A

# Regional AR Lab Network Testing

- *Candida auris* colonization testing
- Non-*albicans* *Candida* spp. identification, antifungal susceptibility testing on isolates
- Carbapenemase colonization testing
  - KPC, IMP, NDM, OXA-48-like, VIM if CRE, CRPA, CRAB
  - OXA-23-, OXA-24/40-, OXA-58-like if CRAB
- Identification, carbapenemase and antimicrobial susceptibility testing (AST) on CRAB, CRE, CRPA isolates
- Expanded AST (highly-resistant CRE isolates)
- Targeted surveillance (CRAB, CRPA, non-*albicans* *Candida* isolates)

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[WA AR Lab Network Test Menu](#)

([www.doh.wa.gov/ForPublicHealthandHealthcareProviders/PublicHealthLaboratories/ARLNLabTestMenu](http://www.doh.wa.gov/ForPublicHealthandHealthcareProviders/PublicHealthLaboratories/ARLNLabTestMenu))



# WA Regional AR Lab Network Lab Testing for CA\*

## Jan 2019 – Jul 2021

Type	# Positive for <i>C. auris</i> (%)	Total Tested
<i>C. auris</i> swabs	724 (5.6%)	13,009
<i>Candida</i> isolates	272 (43%)	630

Type	# Positive for carbapenemase (%)	Total Tested
CPO swabs (including Cepheid and culture)	135 (3.9%)	3,500
CRO/CPO isolates	156 (26%)	600
CRPA	4 (7.7%)	52
CRAB	115 (70%)	165
CRE	37 (9.7%)	383

\*Includes Pasadena and Long Beach, excludes Los Angeles local health jurisdictions

# AR Testing at CDPH: Microbial Diseases Laboratory (MDL)

- Bacterial Diseases Section (BDS)
    - ID confirmation, carbapenemase testing on isolates
      - CRE, *E. coli*, *Klebsiella* and *Enterobacter* spp.
      - CRPA, non-susceptible to cefepime or ceftazidime
  - Molecular Characterization Unit (MCU)
    - Whole genome sequencing (WGS) for CRE, CRPA, CRAB isolates (uncommon or outbreak-related)
  - Mycobacterial, Mycotic and Parasitic Diseases Section
    - *Candida* isolate species identification and confirmation
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# **Carbapenemase Testing at MDL Bacterial Diseases Section (BDS)**



## Where to submit CRO samples

- Routine surveillance samples should be submitted to your local public health lab and subsequently forwarded to BDS as per the MDL Expanded-Carbapenemase Testing FAQ Sheet.
- If your sample is part of an outbreak investigation or other enhanced testing offered by ARL Lab Network you may be directed to submit to another AR Lab Network lab or directly for WGS here at CDPH.

Please use MDL form 'Antimicrobial Susceptibility Testing-AST' to submit samples for routine CRO testing. The most updated submission form and instructions can be found in our [test FAQ on the MDL website](#).

([www.cdph.ca.gov/Programs/CID/DCDC/Pages/MDLSubmissionInstructionsandForms.aspx](http://www.cdph.ca.gov/Programs/CID/DCDC/Pages/MDLSubmissionInstructionsandForms.aspx))

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# What happens when MDL identifies a carbapenemase, other genes of interest?

- Results are reported back to the submitting lab and to AR Lab Network. The CDPH HAI Program is notified. Isolate may be sent for further testing at AR Lab Network regional or CDC labs as appropriate.
  - If we identify a molecular-negative and phenotypic-positive isolate, the results are considered discordant. These isolates are forwarded for further testing as appropriate (AR Lab Network regional or CDC labs, or MCU for WGS).
  - If you find a particular gene/pathogen that we do not routinely test for is causing problems in your facility we can usually arrange for you to submit (either through us or send directly) to AR Lab Network regional or CDC labs as appropriate.
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# AR Lab Network CRO Testing offered at BDS

- Workflow 'Option 1': *P. aeruginosa* (CRPA) and Enterobacterales (CRE) *with* previous genotypic testing.

ID Confirmation by MALDI



mCIM (Phenotypic test)

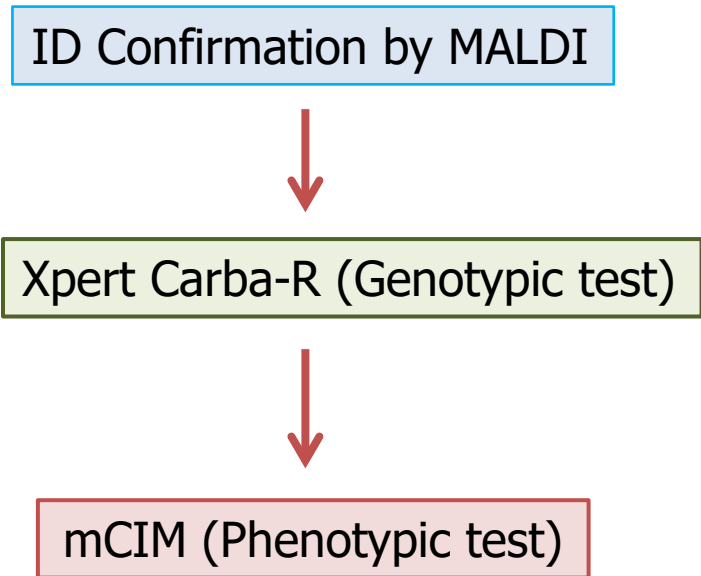


Xpert Carba-R (Genotypic test)



# AR Lab Network CRO Testing offered at BDS

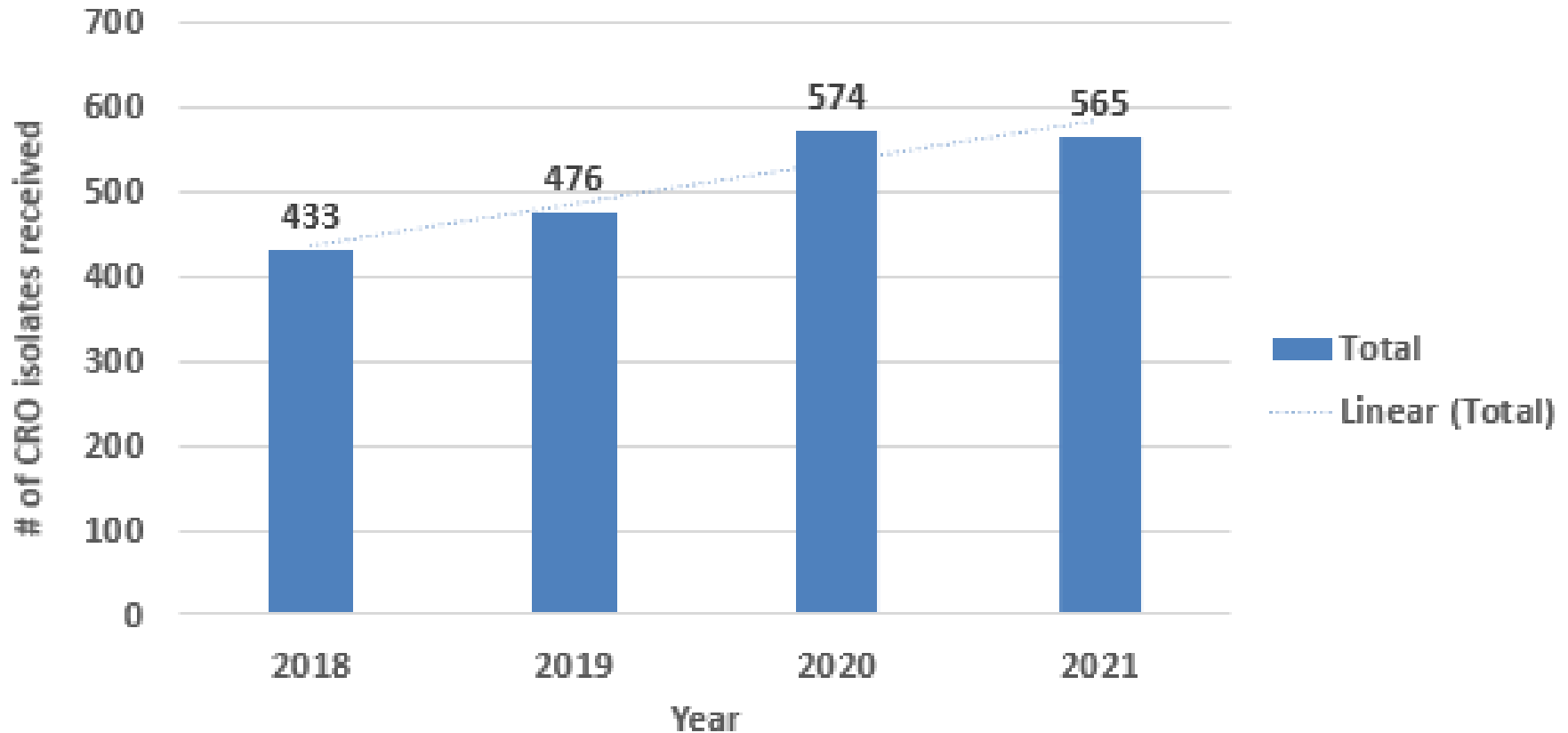
- Workflow 'Option 2':  
Enterobacterales (CRE) *without* previous genotypic testing and *P. aeruginosa* (CRPA) with previous phenotypic testing.



MALDI=matrix assisted laser desorption ionization; mCIM=modified carbapenem inactivation method

# CRO submissions have been increasing from 2018 – Jul 2021

Total Isolates Received for Carbapenemase Testing by Year





# AR Lab Network CRO Testing offered at BDS

- Workflow 'Option 1': *P. aeruginosa* (CRPA) and Enterobacterales (CRE) with previous genotypic testing.

ID Confirmation by MALDI



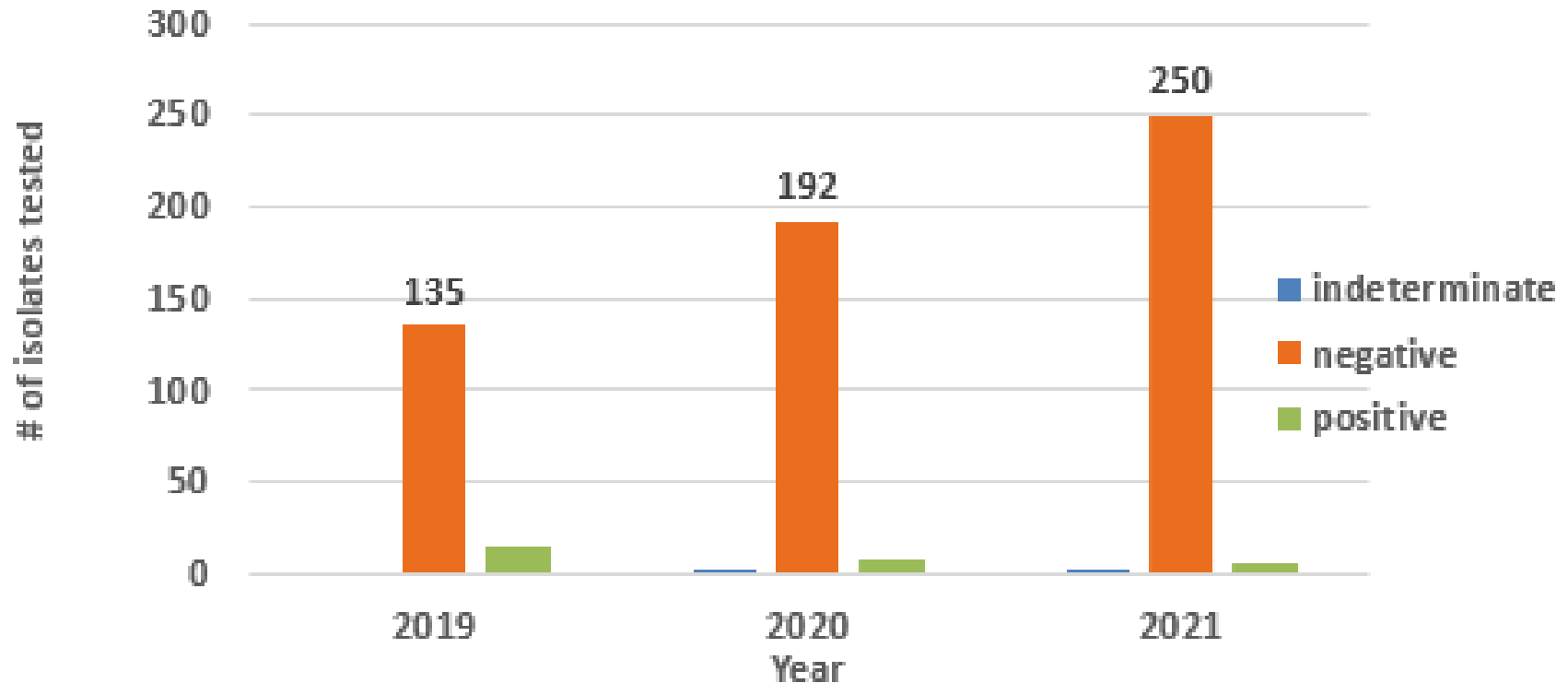
mCIM (Phenotypic test)



Xpert Carba-R (Genotypic test)

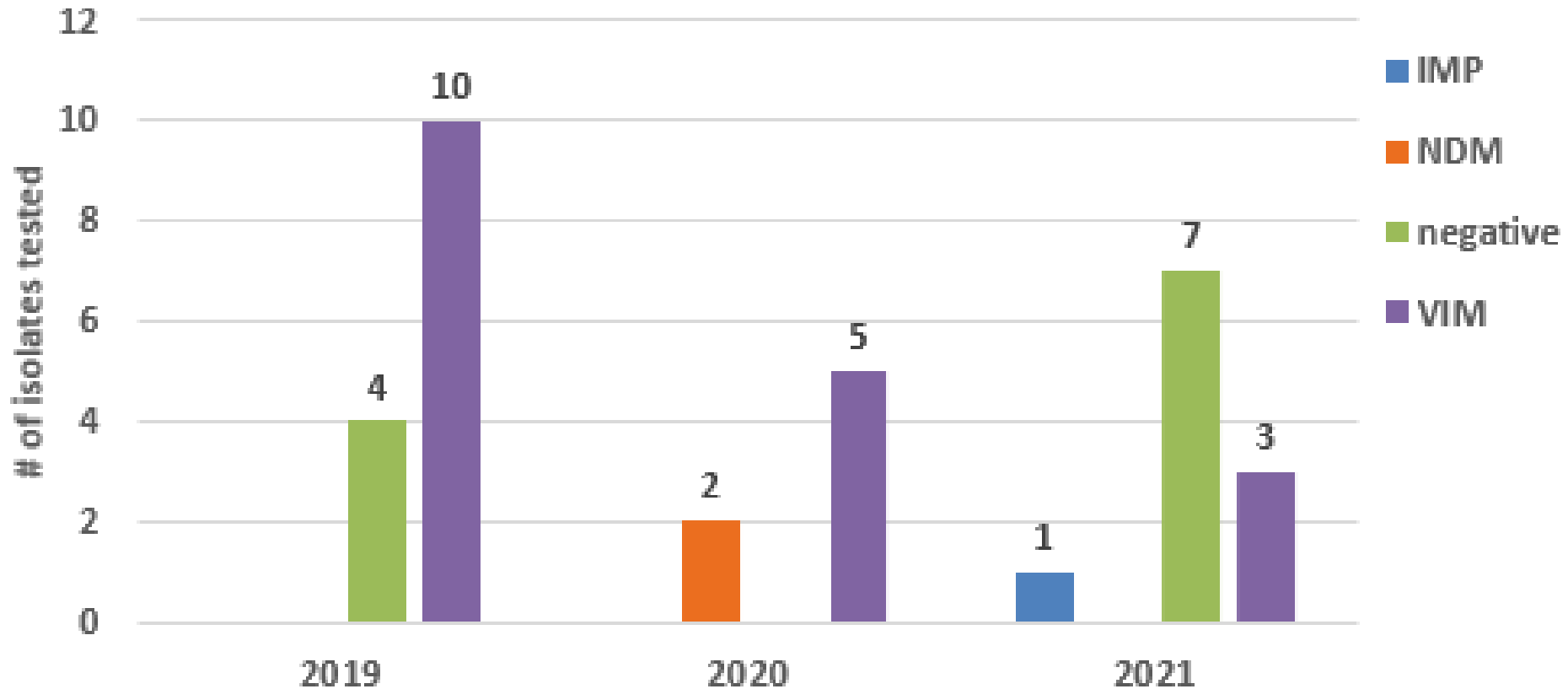
# Number of mCIM tests on CRPA done have been increasing from Jan 2019 – Jul 2021

CRPA mCIM by calendar year



Year	% Positive by mCIM	Total # of isolates
2019	10	150
2020	3.5	200
2021	2.4	258

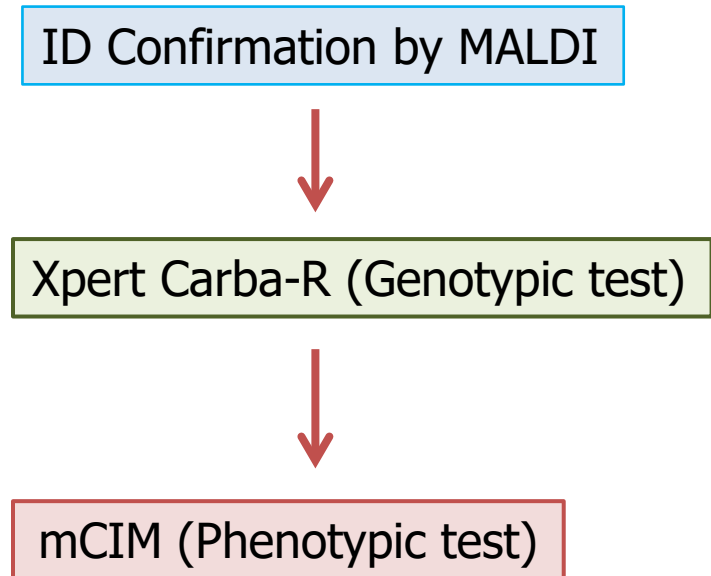
# CRPA Xpert Results by Year, Jan 2019 – Jul 2021



Year	Total % Positive	% IMP Positive	% NDM Positive	% VIM Positive	Total # of isolates
2019	71	0.0	0	71	14
2020	100	0.0	29	71	7
2021	100	9.1	0	27	11

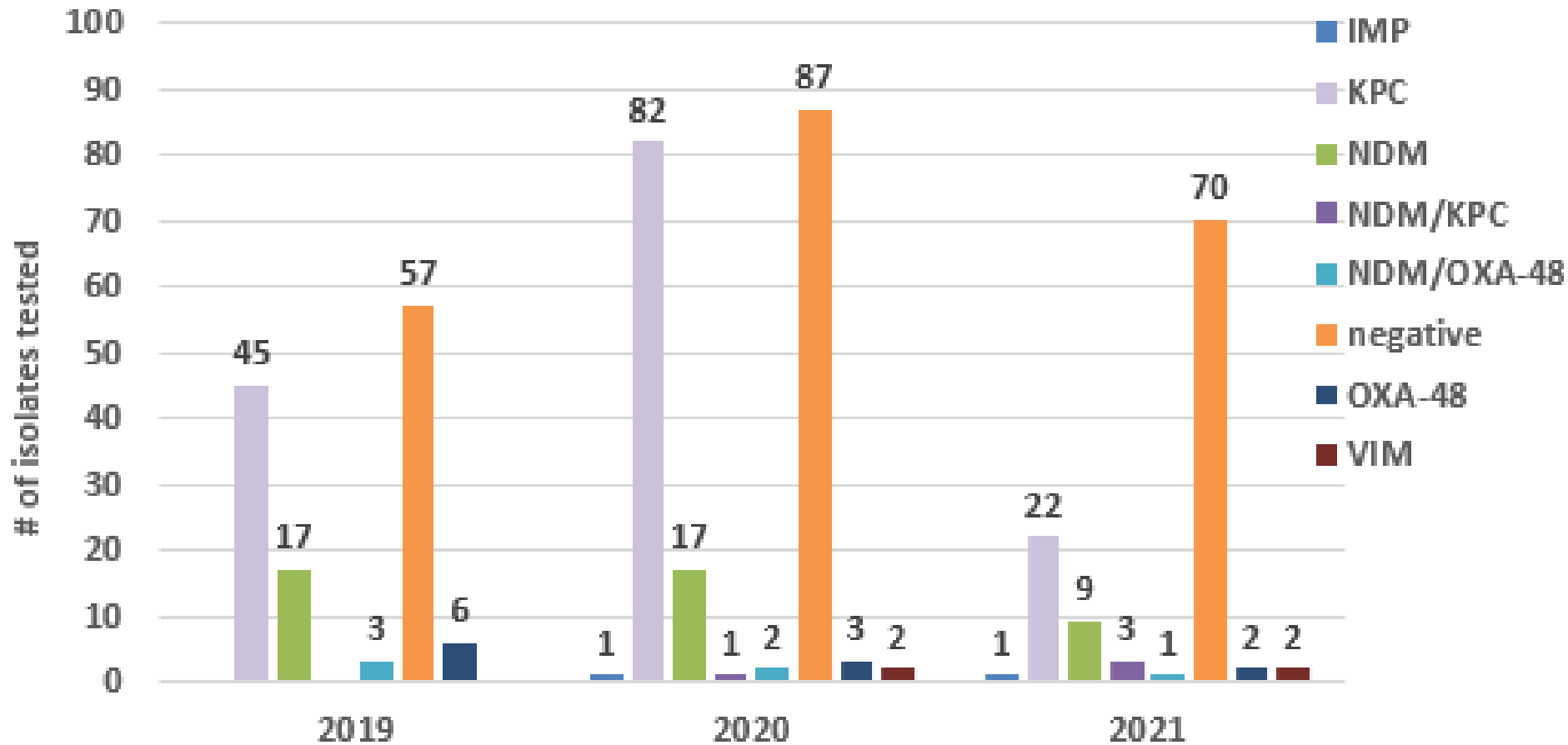
# AR Lab Network CRO Testing offered at BDS

- Workflow 'Option 2':  
Enterobacterales (CRE) *without* previous genotypic testing and *P. aeruginosa* (CRPA) with previous phenotypic testing.



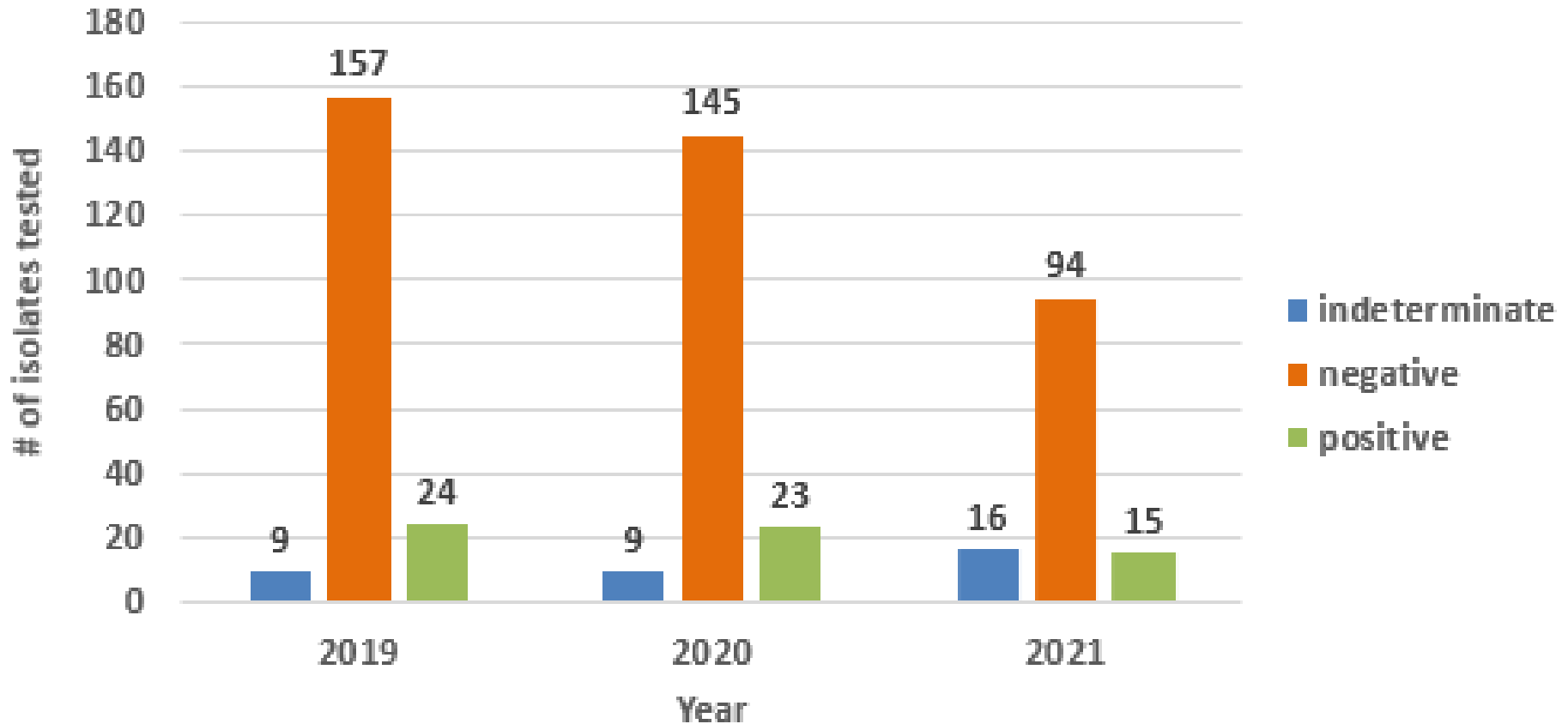
MALDI=matrix assisted laser desorption ionization; mCIM=modified carbapenem inactivation method

# CRE Xpert Results by Year, Jan 2019 – Jul 2021



Year	Total % Positive	% IMP Positive	% KPC Positive	% NDM Positive	% NDM/KPC Positive	% NDM/OXA-48 Positive	OXA-48 Positive	% VIM Positive	Total # of isolates
2019	55	0.0	35	13	0	2	5	0	128
2020	55	0.5	42	9	1	1	2	1	195
2021	36	0.9	20	8	3	1	2	2	110

# CRE mCIM Results by Year, Jan 2019 – Jul 2021



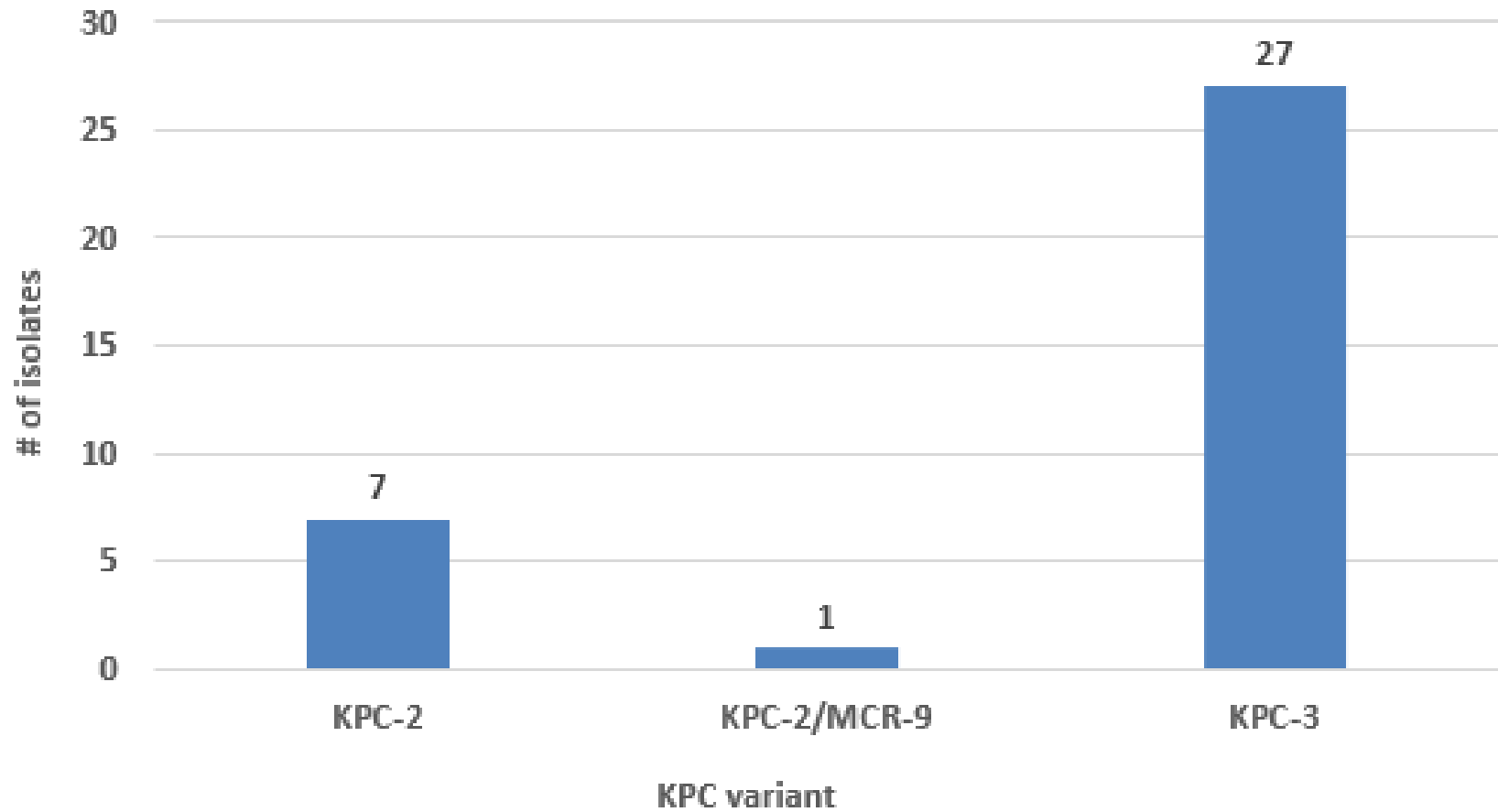
Year	% Positive by mCIM	Total # of isolates
2019	13	190
2020	13	176
2021	16	125

## Whole Genome Sequencing (WGS) at MDL

- The following slides contain data from isolates sequenced by WGS at MDL.
- This is a selection of a mix of reference isolates from outbreaks and others. This is not a representative sample.
  - Includes isolates from 2017 through July 2021
- Additional testing including WGS is done at ARLN regional and CDC labs. That data is not presented here.

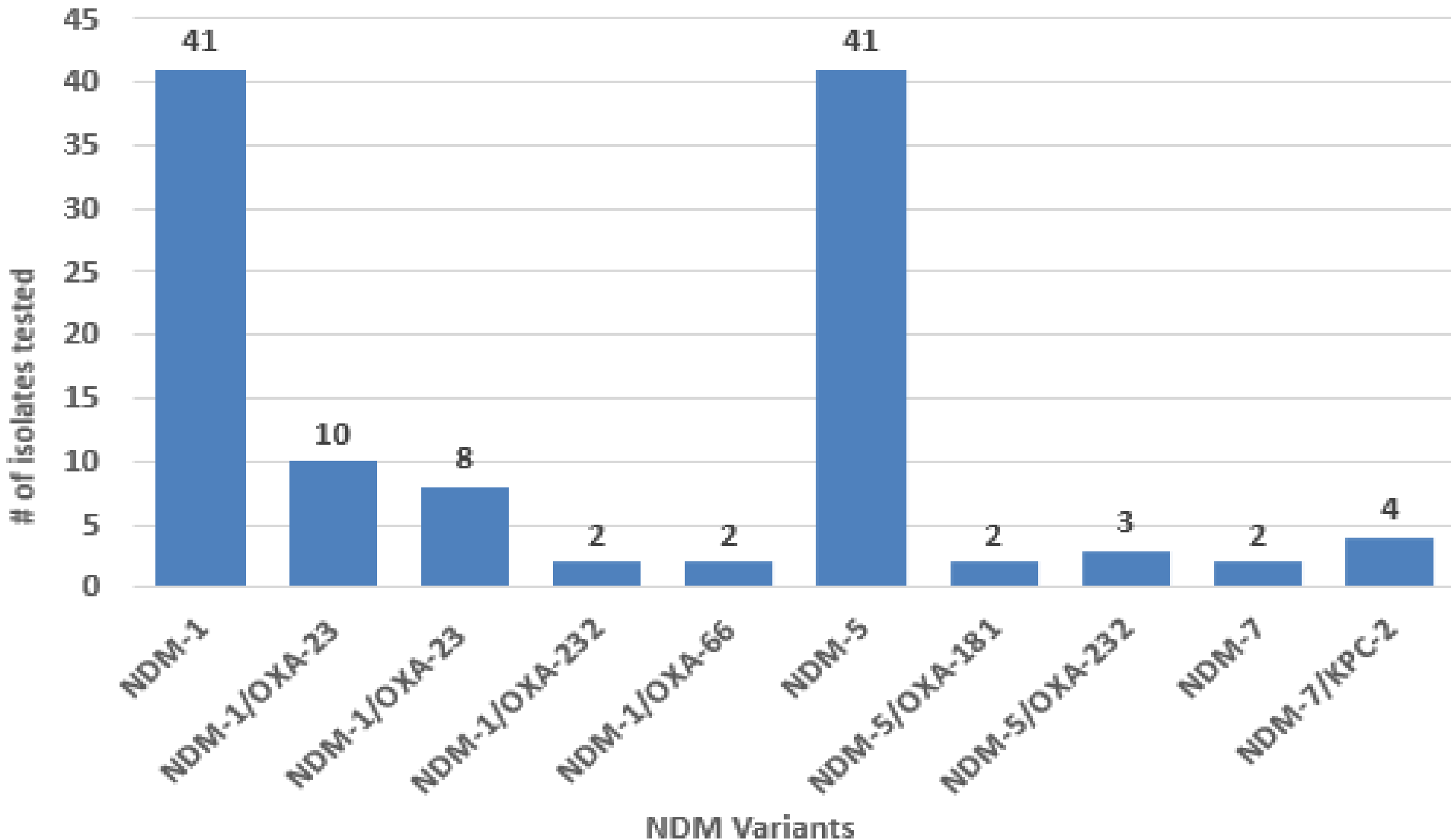


## KPC variants from CRO 2017 – Jul 2021

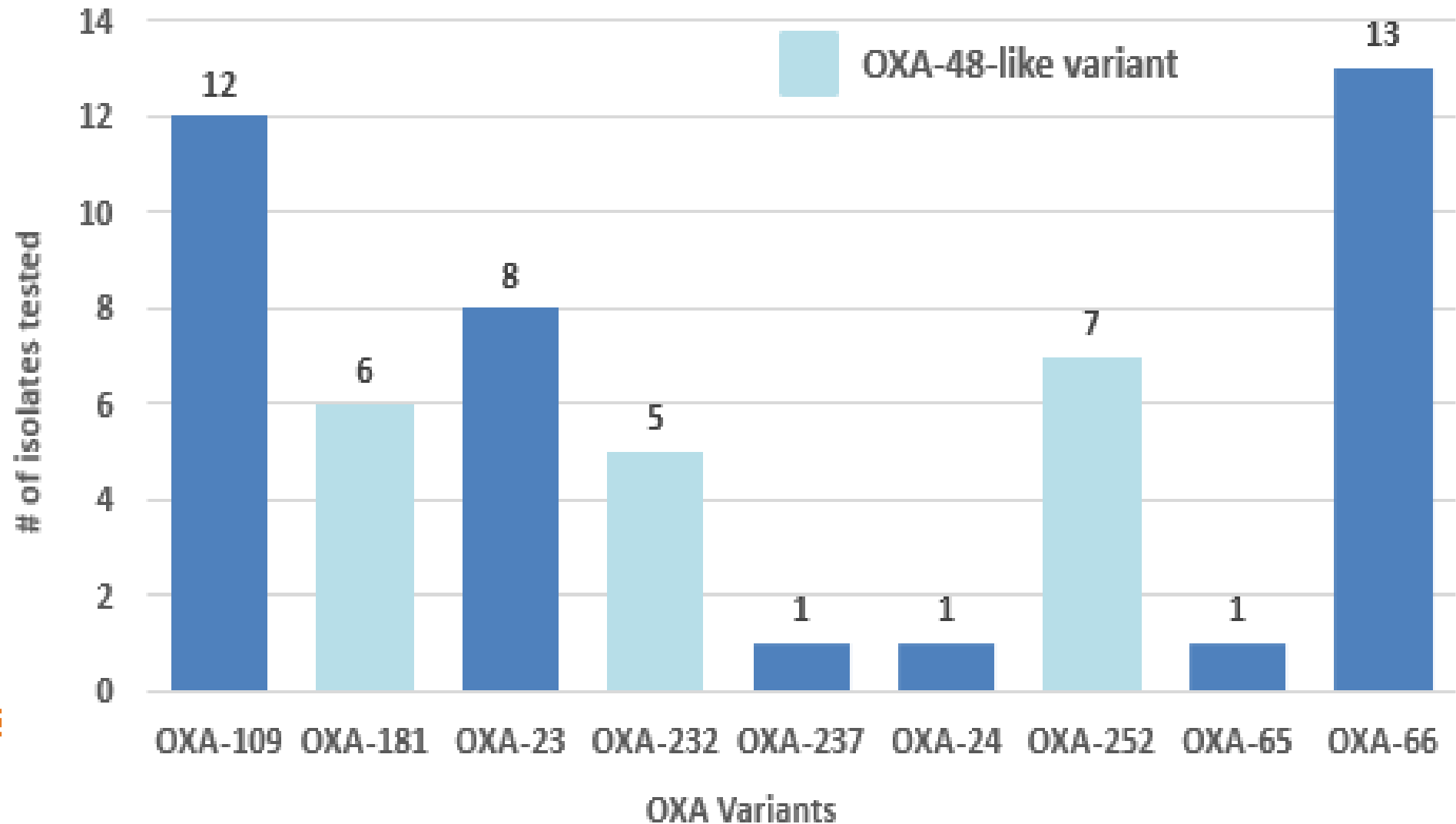




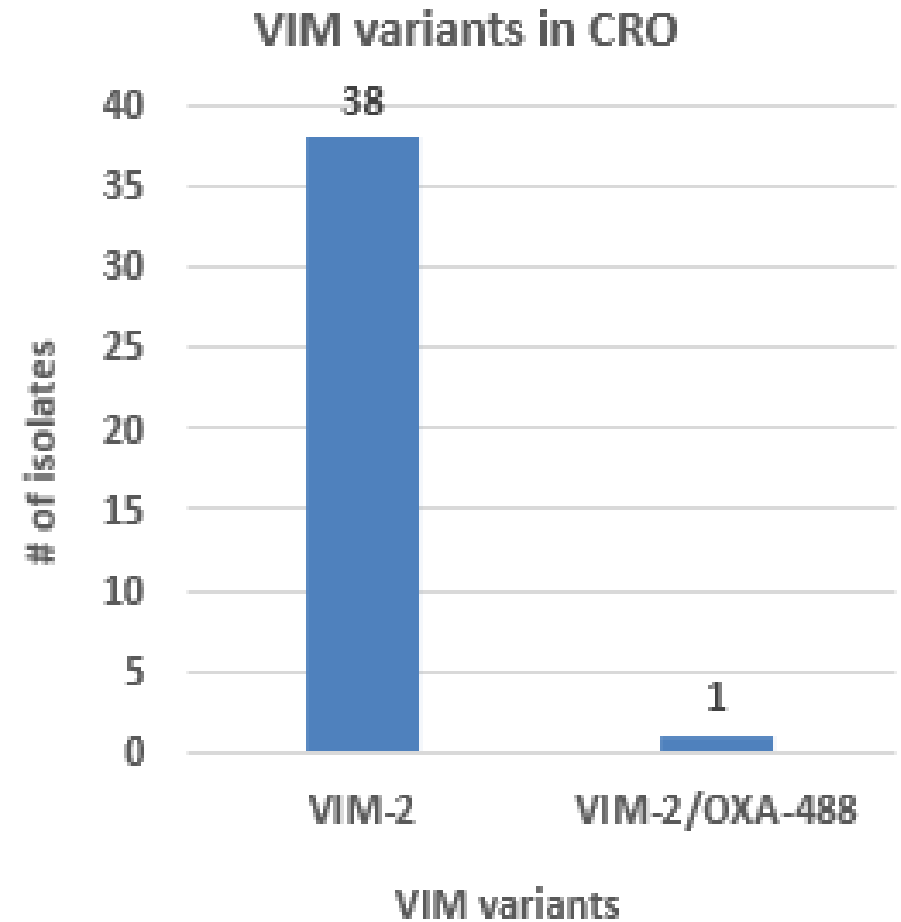
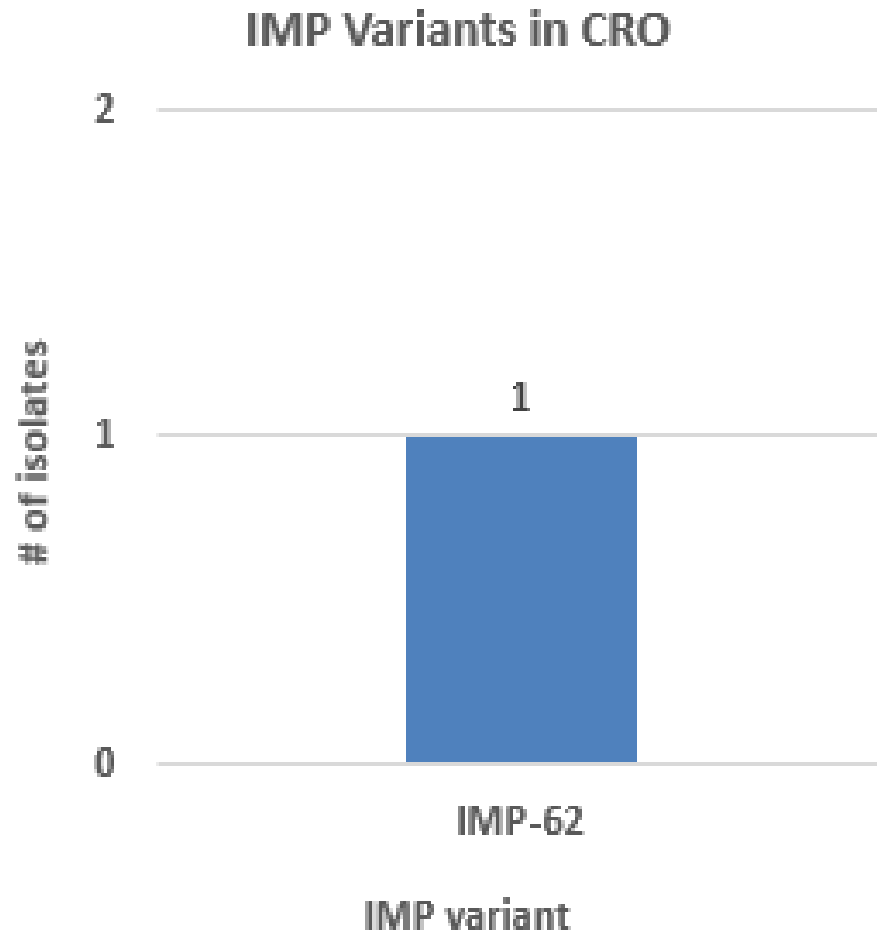
# NDM variants from CRO (including CRAB) 2017 – Jul 2021



# OXA variants from CRO (including CRAB) 2017 – Jul 2021



# IMP and VIM variants from CRO 2017 – Jul 2021



# Other Carbapenemases and Genes of interest to ARLN Found in CA

- Isolates with the SME and IMI carbapenemase genes.
- IMP variants that are not detected by Xpert (IMP-27).
- OXA variants that are not detected by Xpert.
- Isolates that test KPC+ by molecular tests but are phenotypically sensitive to carbapenems.
- *We are in the process of validating a new PCR test (Streack ARM-D Kits) which will expand our capability to detect IMP and OXA variants.*

## Other genes of interest:

- detected MCR-9 and 10 variants in WGS data – not recommended for routine screening but still reported to AR Lab Network when we identify.
    - We follow ‘Alert’ reporting guidance that is updated by AR Lab Network periodically. We can provide this to anyone who is interested.
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## New Tests in 2022

- Sensititre GNX2F panel for CRO organisms
- Etest for *Neisseria gonorrhoeae*

BDS works on many other organisms in addition to CRO and routinely submits isolates/specimens for testing at CDC and other AR Lab Network labs. Please contact us if there are other tests and services you would like access to.





# **Whole Genome Sequencing at MDL Molecular Characterization Unit (MCU)**

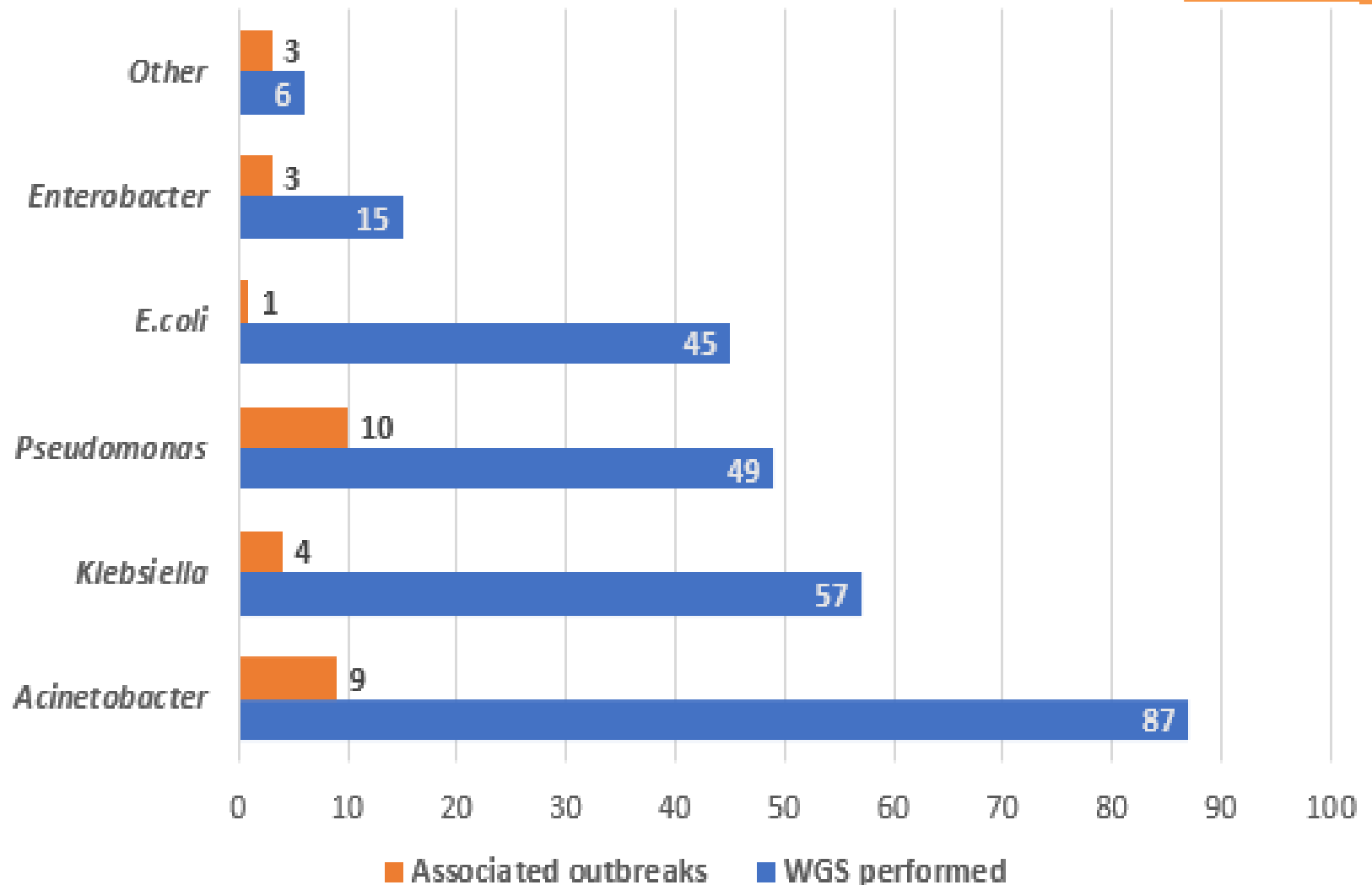


# Whole Genome Sequencing (WGS)

- WGS on non-PulseNet organisms, HAI organisms, Mycobacterium, etc.
- HAI organisms include:
  - CPO (n=259): *Acinetobacter baumannii*, *Enterobacter cloacae*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*
  - Non-CPO (n=191): *Serratia marcescens*, *Staphylococcus aureus*, *Corynebacterium striatum*, *Stenotrophomonas maltophilia*



# WGS Summary of AR organisms, Nov 2019 – Jul 2021 (n=259)





# WGS Performed and Genes Detected, Nov 2019 – Jul 2021 (n=259)

Organism	WGS performed	Genes detected			
		NDM	OXA	KPC	VIM
<i>Acinetobacter</i>	87	blaNDM-1	blaOXA-109, blaOXA-252, blaOXA-23, blaOXA-66, blaOXA-99		
<i>Klebsiella</i>	57	blaNDM-1, blaNDM-5, blaNDM-7	blaOXA-1, blaOXA-9, blaOXA-232, blaOXA-515, blaOXA-181, blaOXA-252;	blaKPC-2, blaKPC-3	
<i>Pseudomonas</i>	49	blaNDM-1	blaOXA-50, blaOXA-488, blaOXA-396		blaVIM-2
<i>E.coli</i>	45	blaNDM-1, blaNDM-4, blaNDM-5, blaNDM-7	blaOXA-1, blaOXA-9, blaOXA-181	blaKPC-2, blaKPC-3	
<i>Enterobacter</i>	15	blaNDM-7		blaKPC-2	
Other	6	blaNDM-1	blaOXA-1, blaOXA-10, blaOXA-181	blaKPC-2	

# WGS Submission Requirements

- Isolates from patients being investigated as part of an outbreak or containing novel resistance mechanisms
  - Approval required by HAI Program or MCU
  - Isolates should be submitted with completed [submission form \(WGSR form for WGS\)](#)  
([www.cdph.ca.gov/Programs/CID/DCDC/Pages/MDLSubmissionInstructionsandForms.aspx](http://www.cdph.ca.gov/Programs/CID/DCDC/Pages/MDLSubmissionInstructionsandForms.aspx))
  - Pure isolates are accepted; mixed cultures will not be tested
  - Isolates must be identified by the submitter
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# WGS Report

- Reports are used for epidemiology/surveillance purpose and by infection control program for outbreak investigations
- Official report is provided
- Report includes:
  - *In-silico* Multi-Locus Sequence Typing information
  - Predicted AR genes
  - Phylogenetic tree and single-nucleotide polymorphisms (SNP) matrix to compare isolates for relatedness





# ***Candida* Testing at MDL Mycobacterial, Mycotic and Parasitic Diseases Section**



# Current testing capacities

## Yeast identification, including *Candida* spp.

- Methods: MALDI-TOF MS, Sanger sequencing (18S rRNA and ITS regions)
- Current status: validated in 2016
- Number of isolates tested per month: ~20-35
- Number of facilities sending isolates per month: 4-5 county laboratories (representing unknown number of clinical facilities)

## Referral:

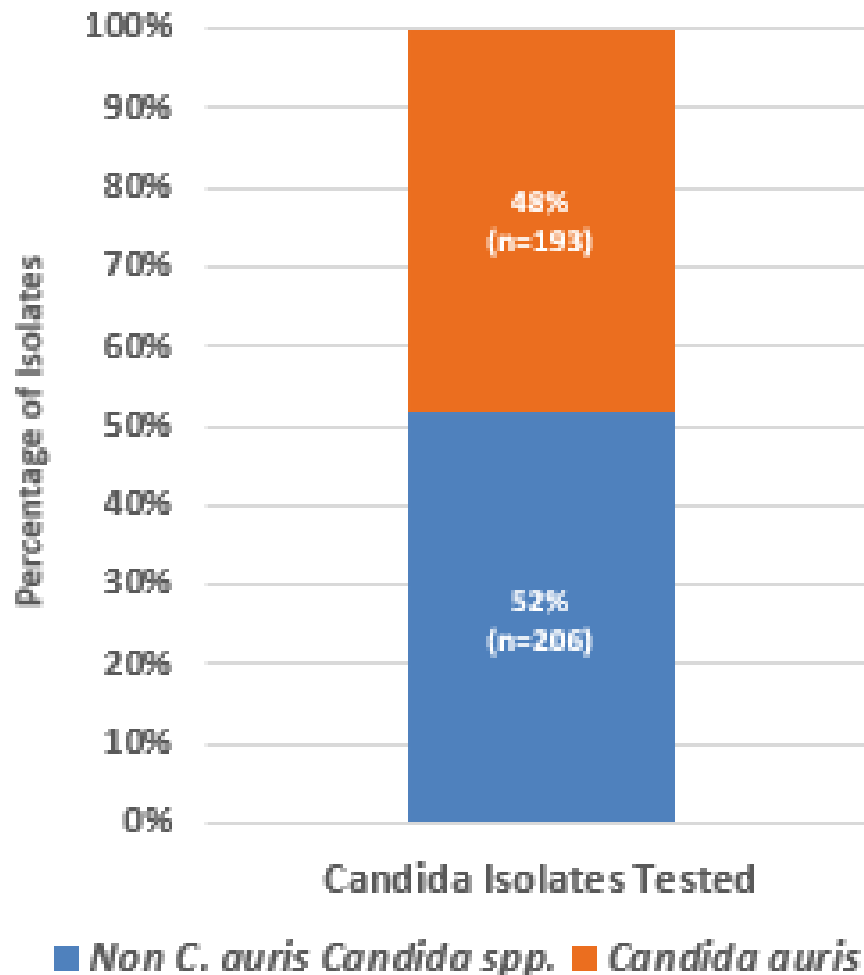
All *Candida* spp. except for *C. albicans* sent to WA AR Lab Network lab for antifungal susceptibility testing.

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# Candida Isolate Testing, Sep 2019 – Jul 2021

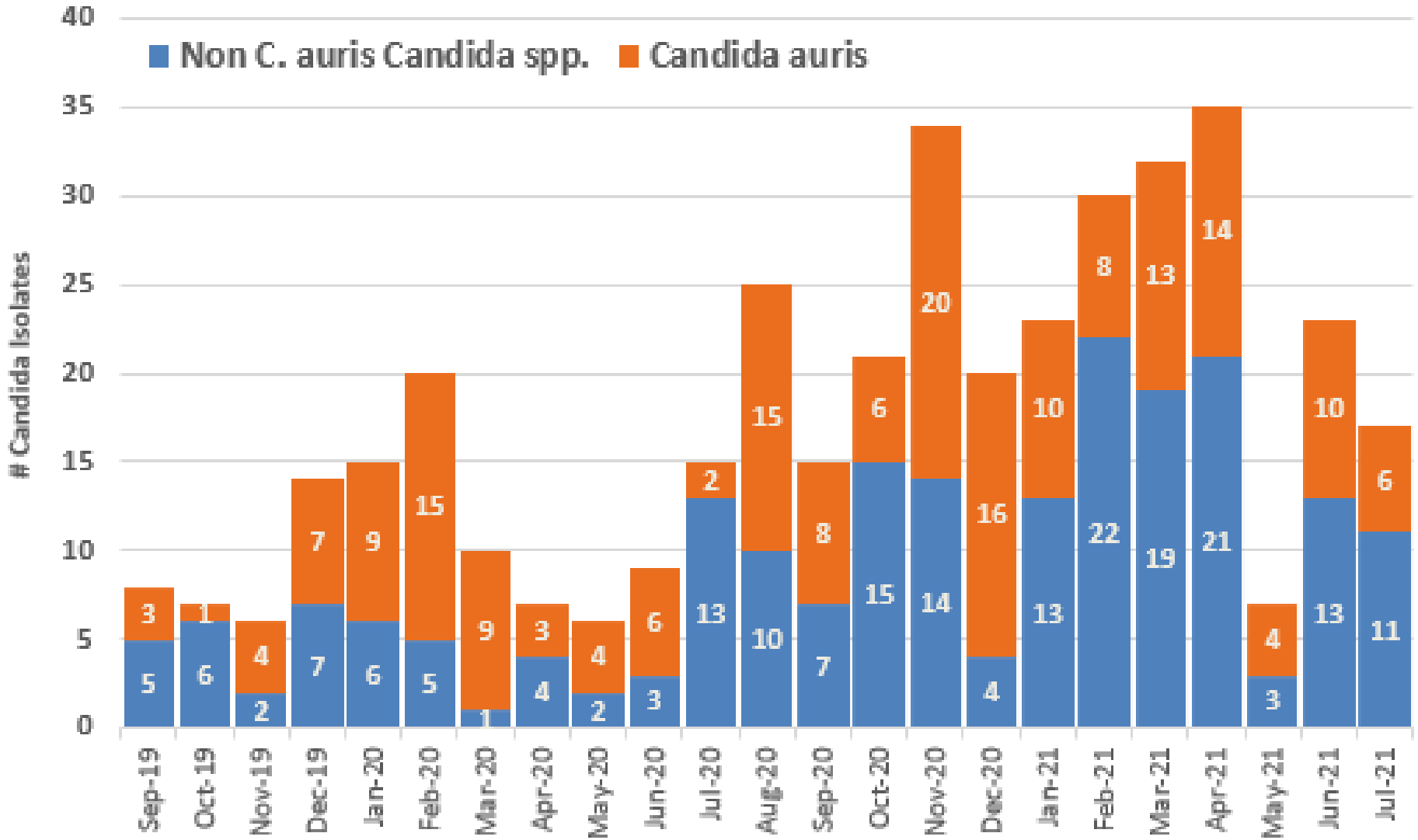
% *Candida* Isolates by Species  
Sep 2019 - Jul 2021



Species Identified	# Isolates	% Isolates
<i>Candida auris</i>	193	48.37%
<i>Candida albicans</i>	57	14.29%
<i>Candida glabrata</i>	42	10.53%
<i>Candida parapsilosis</i> *	41	10.28%
<i>Candida tropicalis</i>	25	6.27%
<i>Candida lusitanae</i> *	9	2.26%
<i>Candida dubliniensis</i>	8	2.01%
<i>Candida orthopsilosis</i>	7	1.75%
<i>Candida krusei</i>	4	1.00%
<i>Candida kefyr</i>	2	0.50%
<i>Candida blankii</i>	1	0.25%
<i>Candida bracarensis</i>	1	0.25%
<i>Candida catenulata</i>	1	0.25%
<i>Candida duobushaemulonii</i> *	1	0.25%
<i>Candida fermentati</i>	1	0.25%
<i>Candida lambica</i>	1	0.25%
<i>Candida metapsilosis</i>	1	0.25%
<i>Candida oleophila</i>	1	0.25%
<i>Candida palmioleophila</i>	1	0.25%
<i>Candida sake</i> *	1	0.25%
<i>Candida vulturna</i>	1	0.25%
<b>Total Candida Isolates Tested</b>	<b>399</b>	

\**Candida auris* can be misidentified as these species when using traditional phenotypic methods for yeast identification

# Candida Isolate Testing, Sep 2019 – Jul 2021



# *Candida* Isolate Testing, Sep 2019 – Jul 2021


Percentage <i>Candida</i> Isolates Tested By Jurisdiction		
Submitter	# Isolates	% Isolates
Orange	196	49.12%
Contra Costa	112	28.07%
Monterey	48	12.03%
Alameda	15	3.76%
Sacramento	11	2.76%
Butte	3	0.75%
San Bernardino	3	0.75%
Ventura	3	0.75%
Napa-Solano-Yolo-Marin-Mendocino	2	0.50%
San Mateo	2	0.50%
Long Beach	1	0.25%
San Diego	1	0.25%
Sonoma	1	0.25%
TPMG Regional Laboratory	1	0.25%
<b>Total <i>Candida</i> Isolates Tested</b>	<b>399</b>	



# Upcoming Testing



## ***Candida auris* colonization screening**

- Methods: BD-Max PCR (Bio-GX), CHROMagar, MALDI-TOF MS
  - Current status: in process of validation (new staff recruited in the past month, specimens received from WA state public health lab, validation plan written, staff training in process)
  - Expected number of isolates tested per month: ~300 (more with additional funding and staffing)
  - Expected timeline: Plan to start receiving swabs by end of 2021
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# MDL Testing and Submission Instructions

- For more information on testing and submission instructions please visit the [MDL website and test menu](http://www.cdph.ca.gov/Programs/CID/DCDC/Pages/MDLServicesAndTestCatalog.aspx)  
([www.cdph.ca.gov/Programs/CID/DCDC/Pages/MDLServicesAndTestCatalog.aspx](http://www.cdph.ca.gov/Programs/CID/DCDC/Pages/MDLServicesAndTestCatalog.aspx))





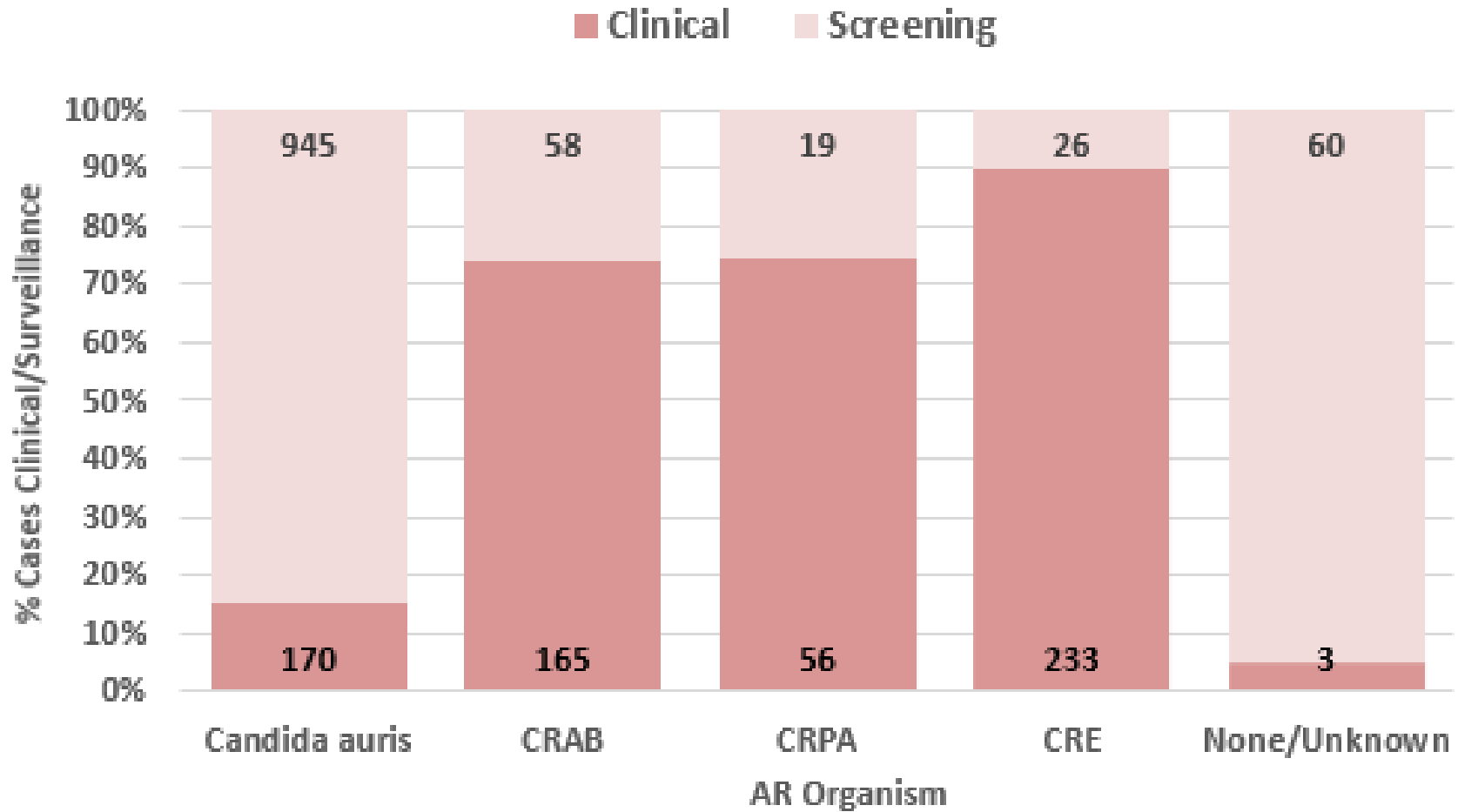
# **AR Cases Reported to CDPH, January 2019 – July 2021**



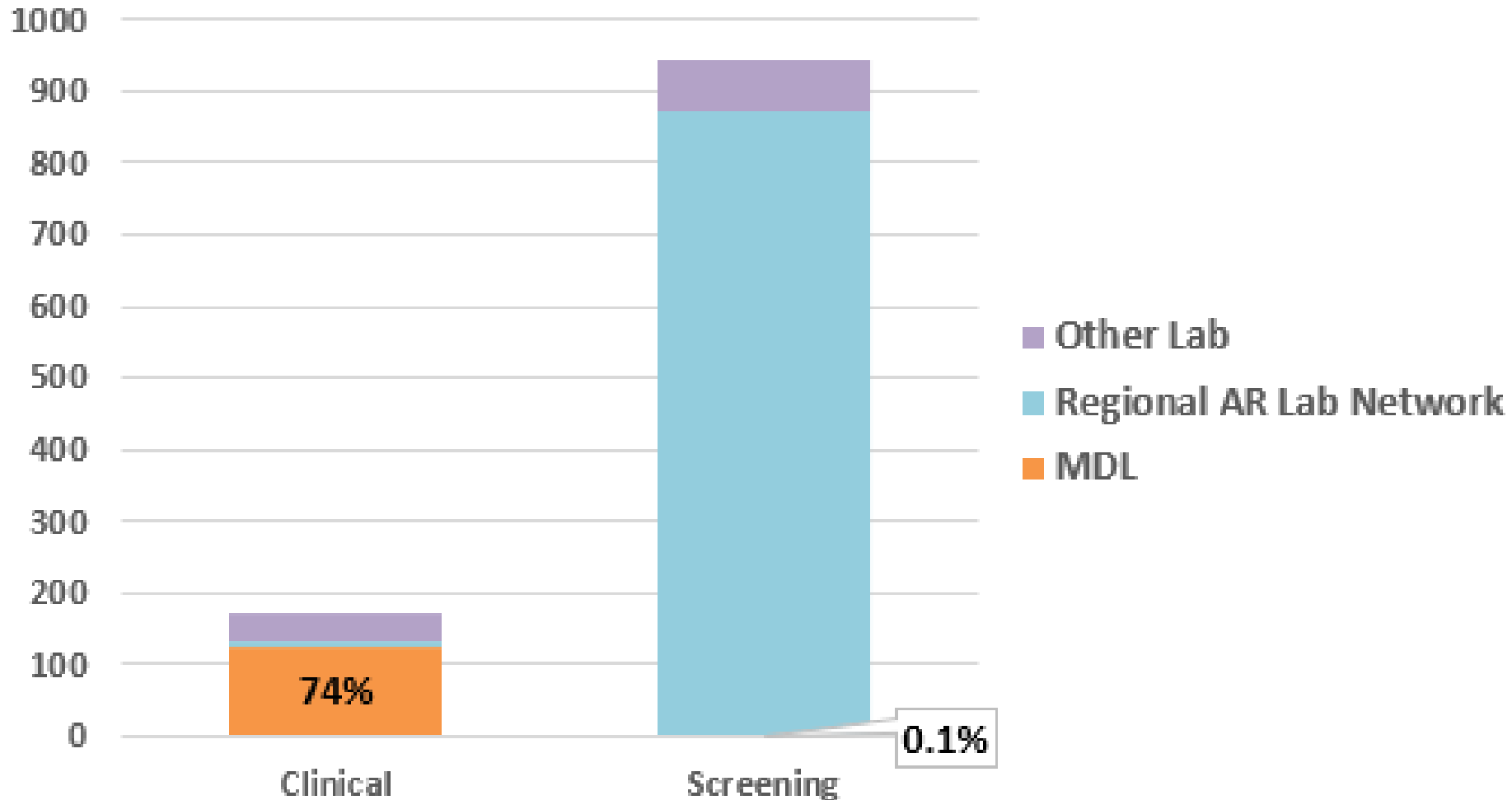
# Antimicrobial-Resistant (AR) Cases

- *Candida auris*
  - Carbapenemase-producing organisms (CPO)
    - CRAB, CRE, CRPA
  - Incident colonization/screening and clinical cases
    - Clinical *C. auris* case may also be counted as prior screening case
  - All local health jurisdictions **excluding** Los Angeles
  - January 1, 2019 – July 31, 2021
  - Only include cases reported to CDPH
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# Percent Clinical Isolate vs. Colonization/Screening Cases by AR Organism (n=1735)

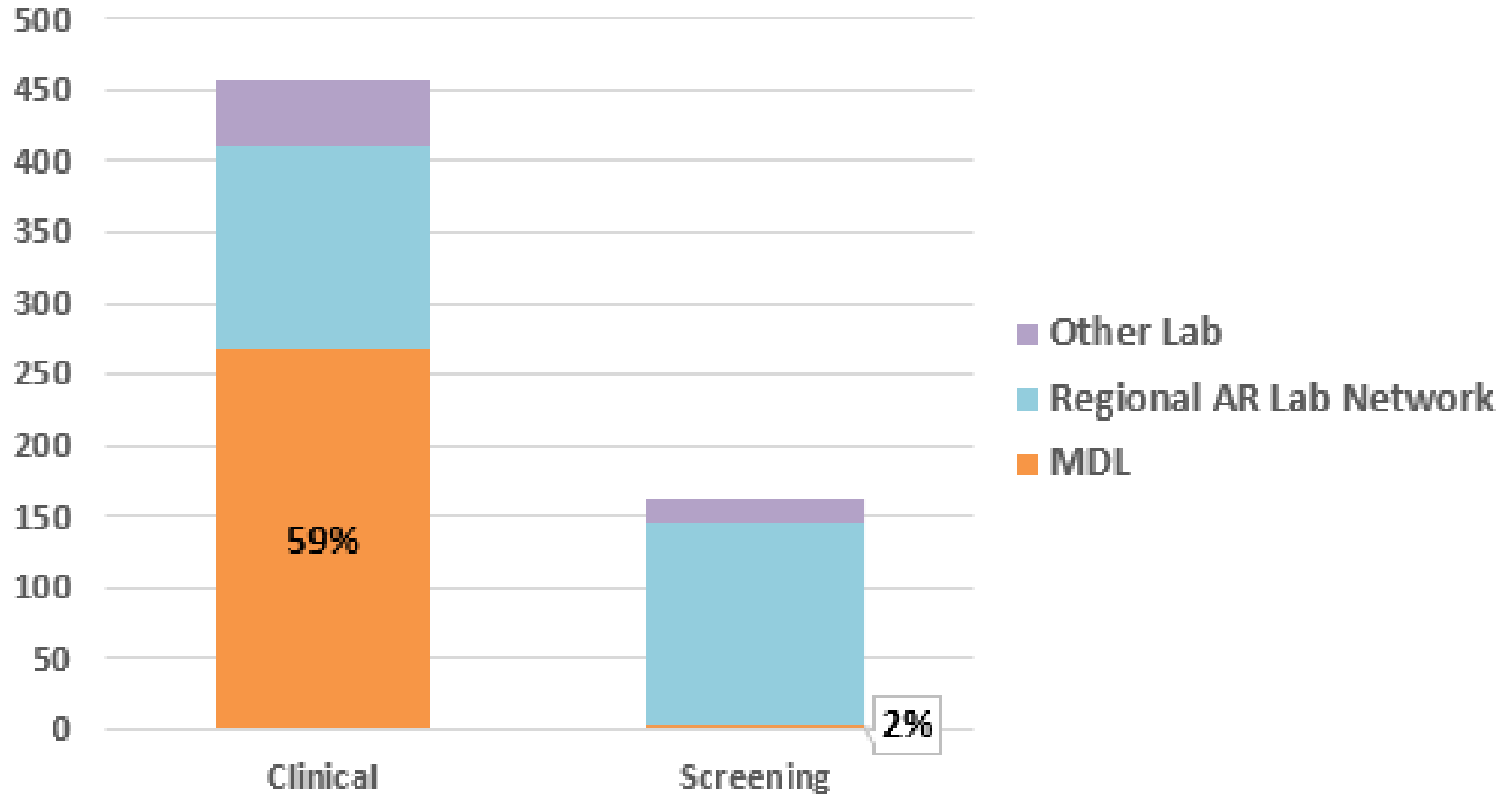


## *C. auris* Cases by Testing Lab\* (n=1115)

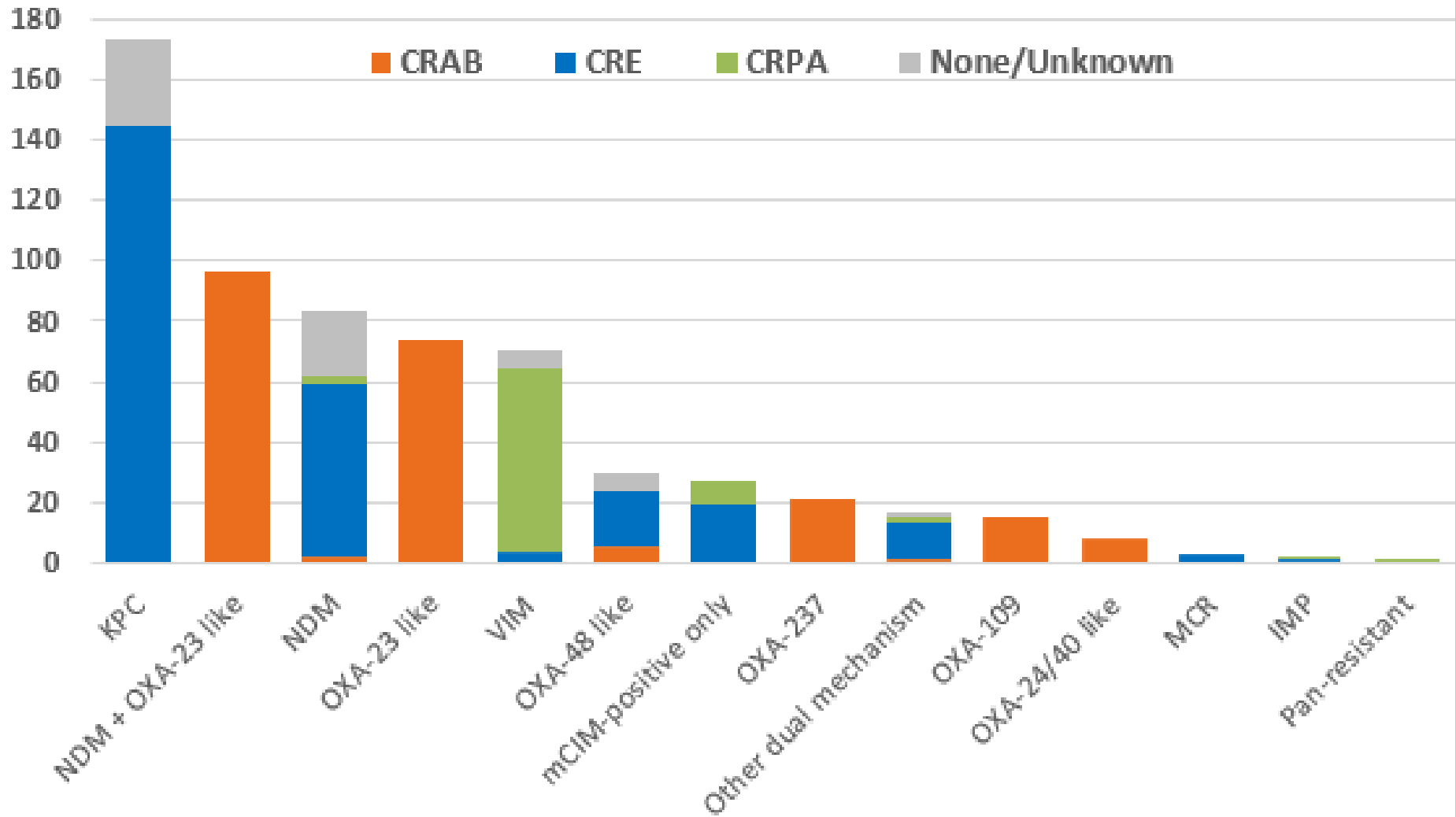


\*All clinical isolates tested at MDL are forwarded to Regional AR Lab Network for further characterization

## CPO Cases by Testing Lab (n=620)

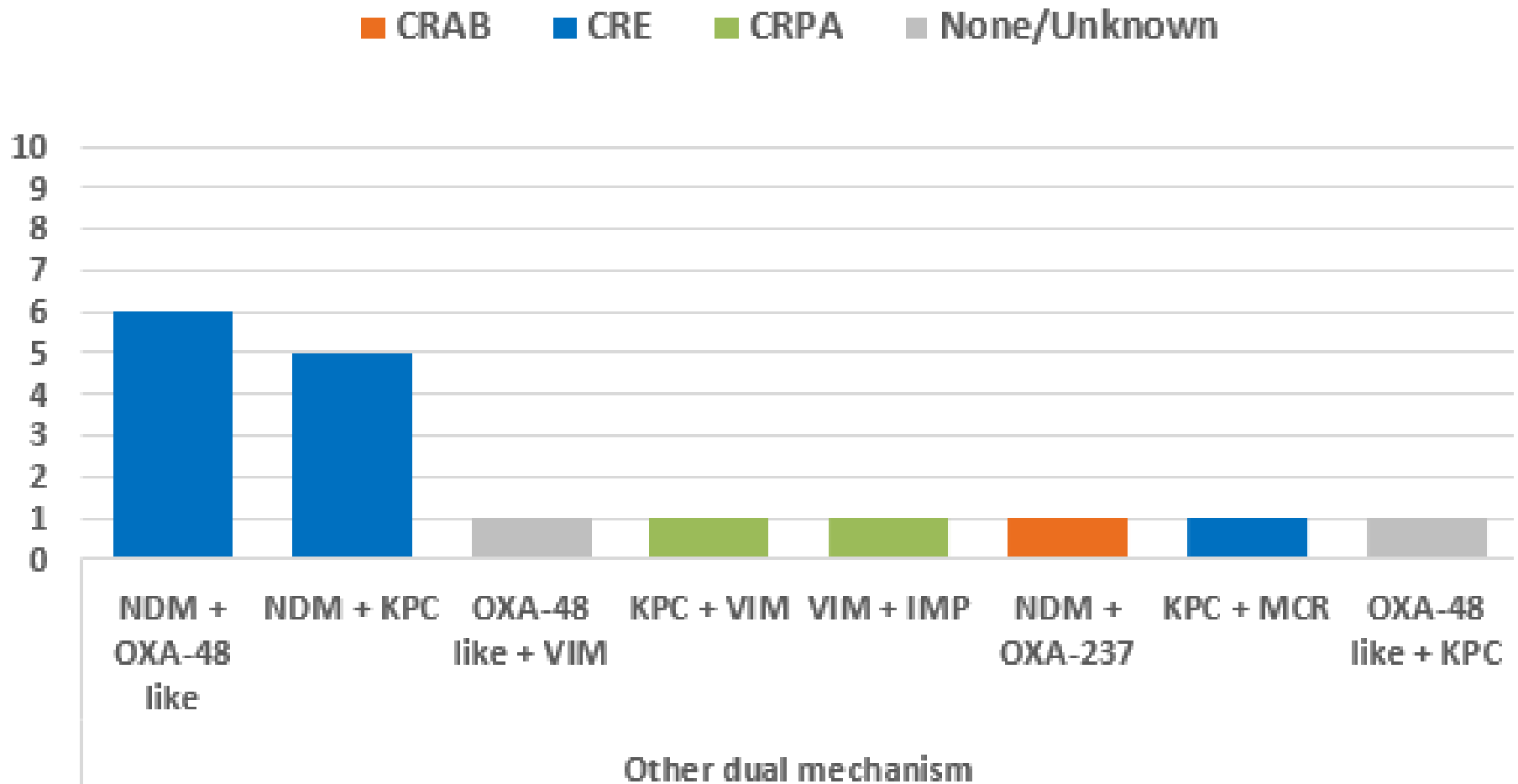


# CPO Cases by Resistance Mechanism (n=620)

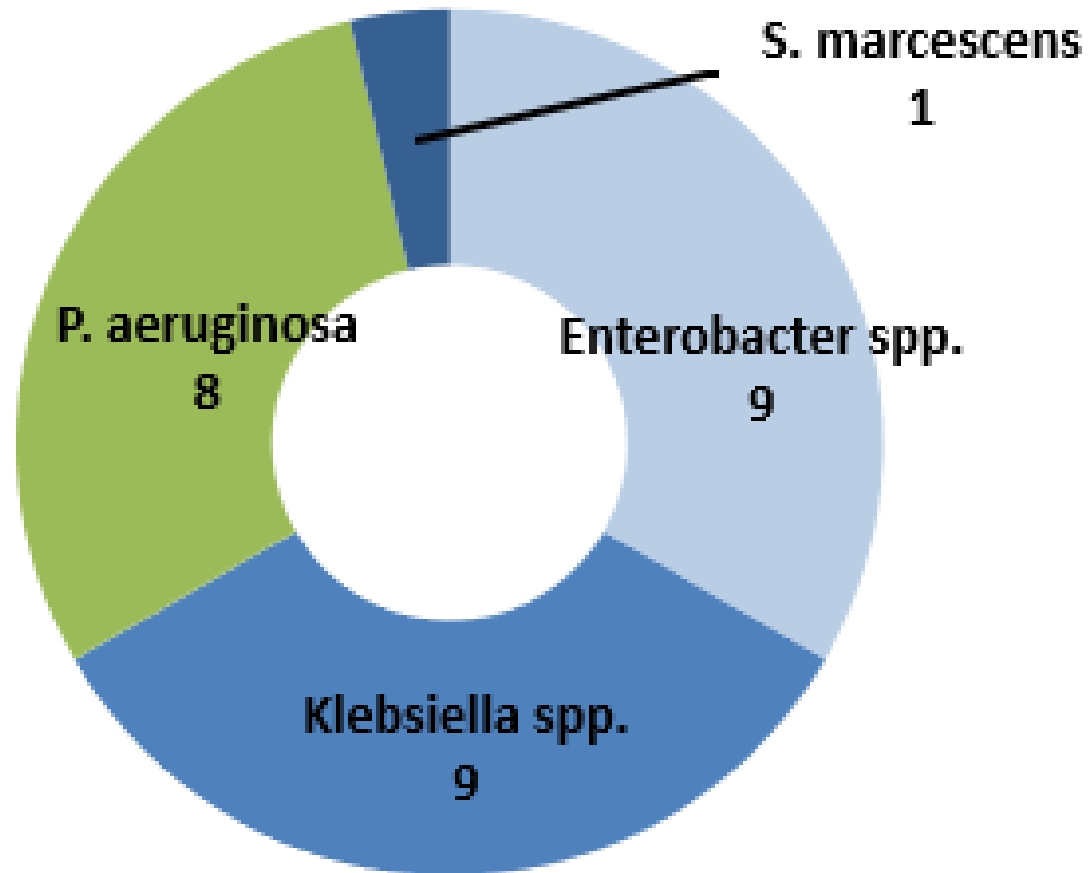




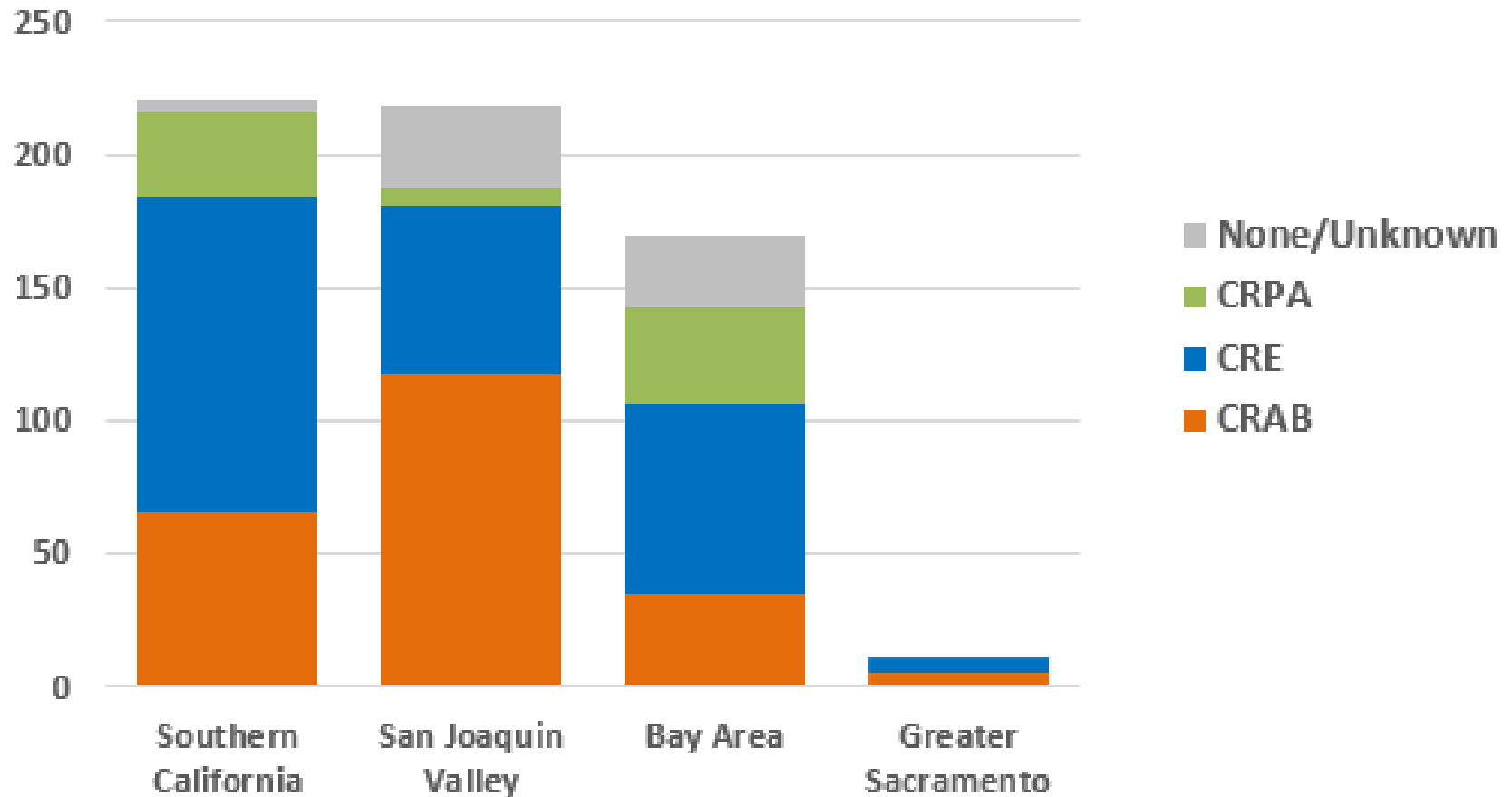
# Dual Mechanism CPO Cases (n=17)



## mCIM-positive only Cases (n=27)



# CPO Cases by CA Local Health Officer Region

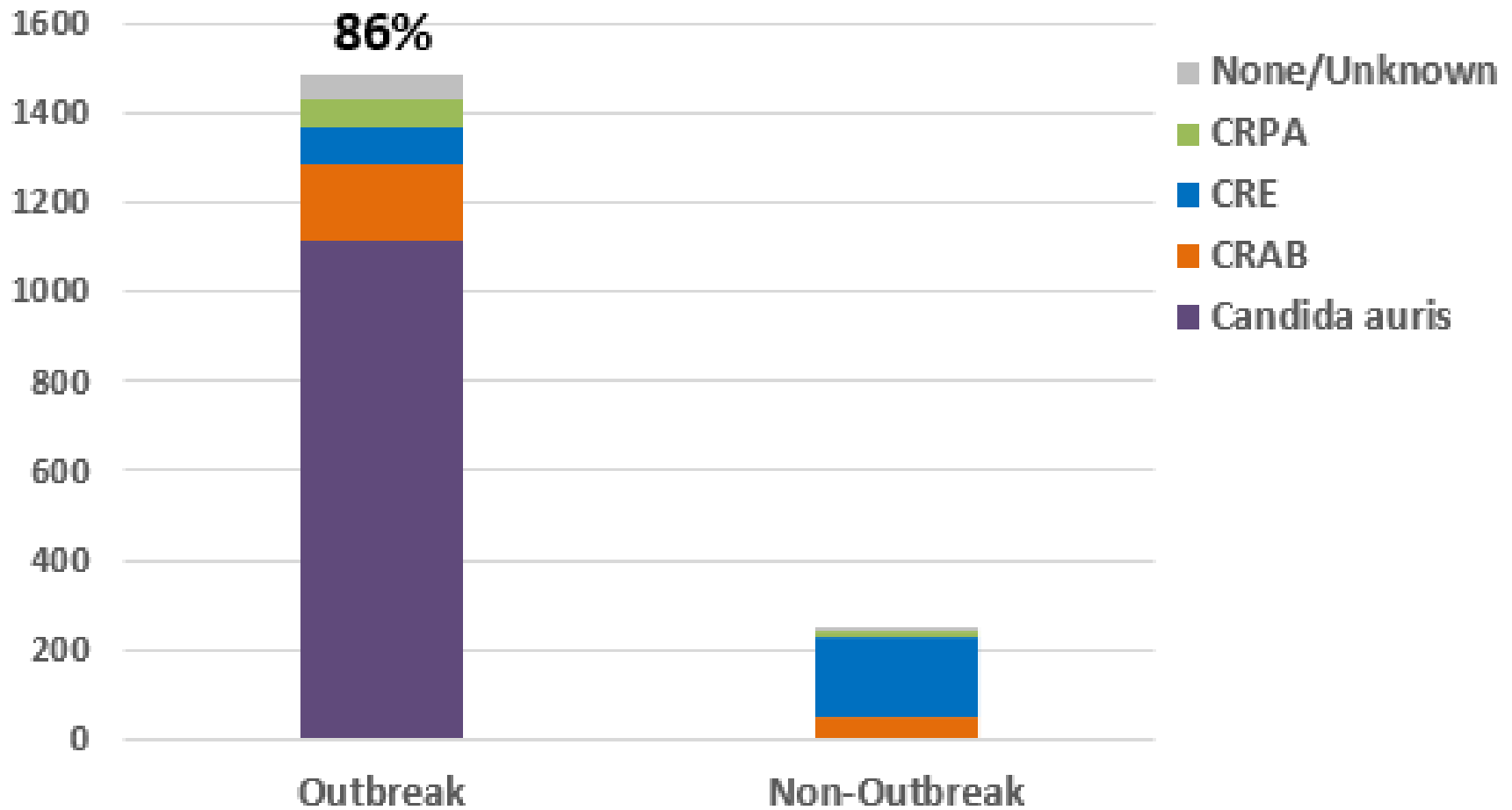




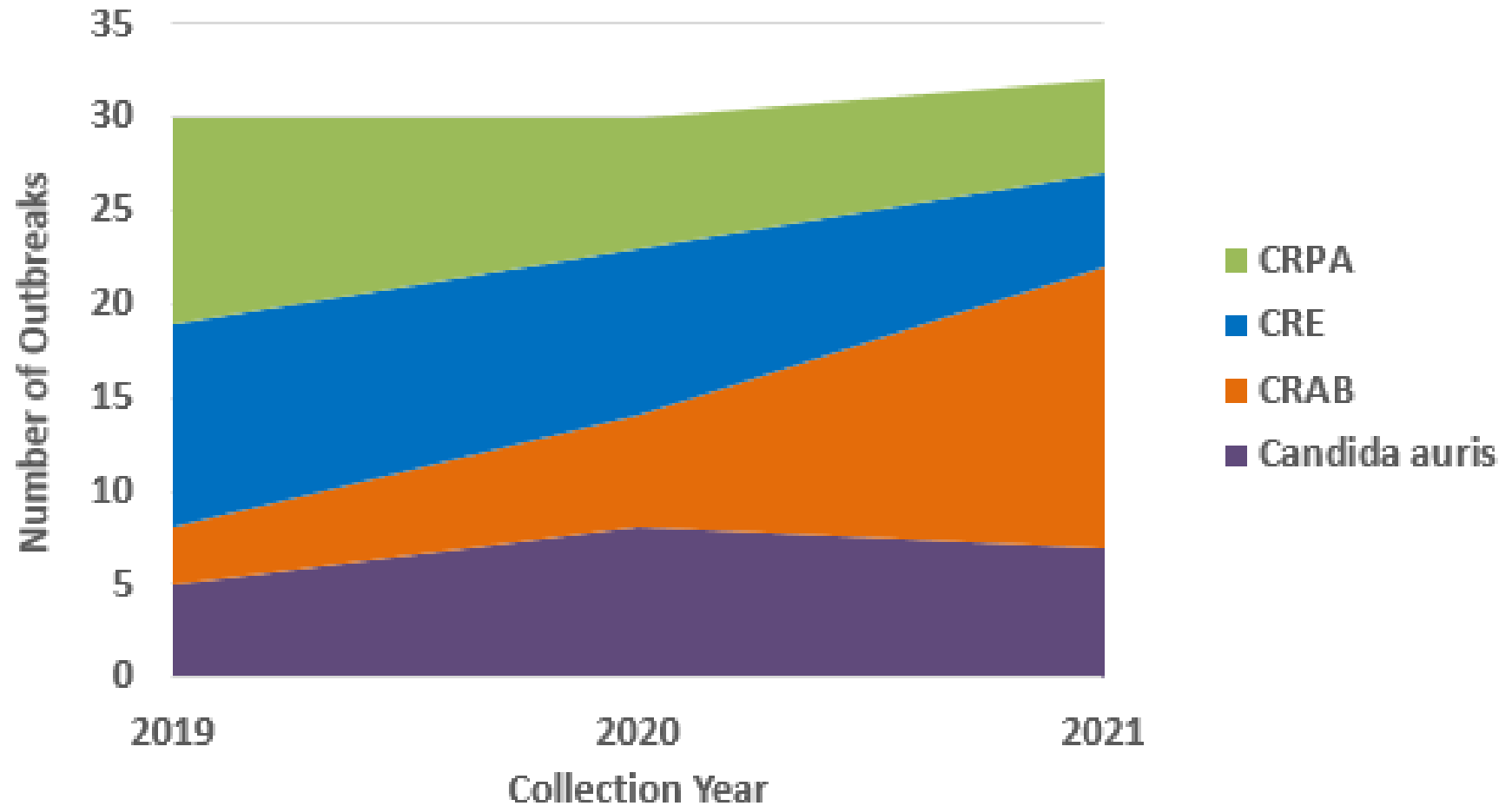
# AR Outbreaks



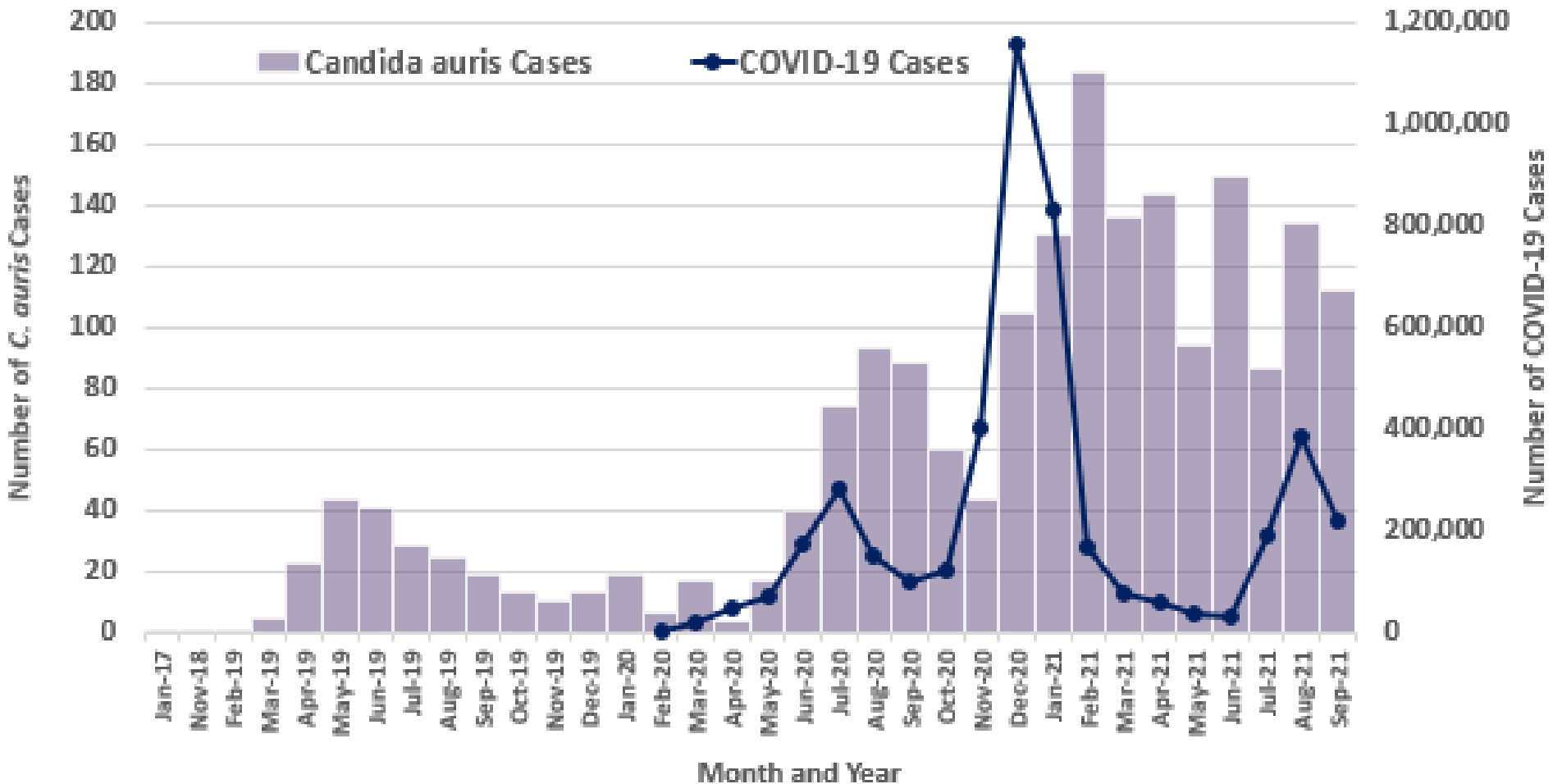
# AR Cases by Pathogen: Outbreak vs. Non-Outbreak



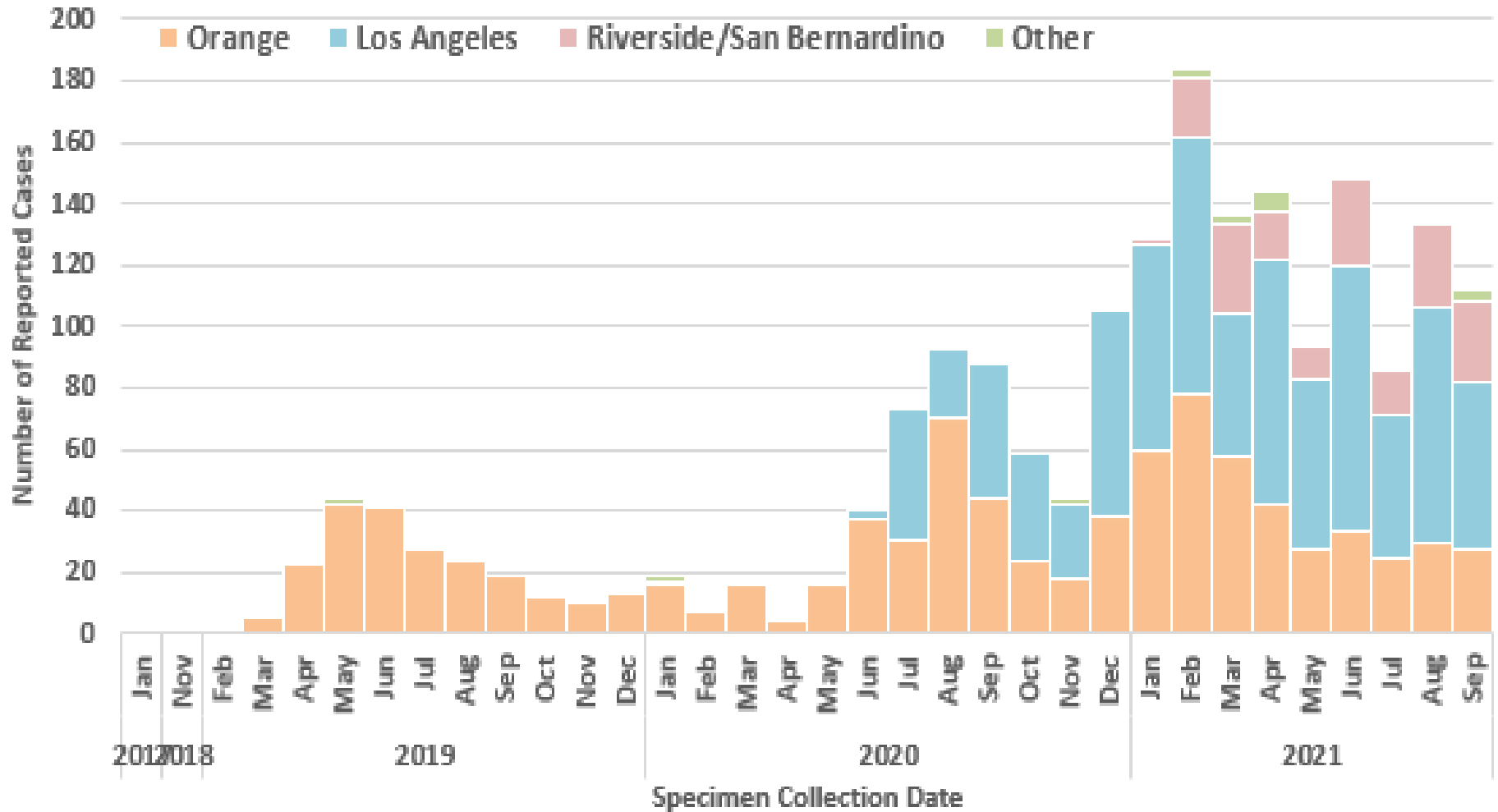
# Number of Outbreaks by Pathogen, Year (n=92)



## *C. auris* resurgence during COVID-19 pandemic



## *C. auris* Cases by LHJ through Sep 2021 (N=1960)

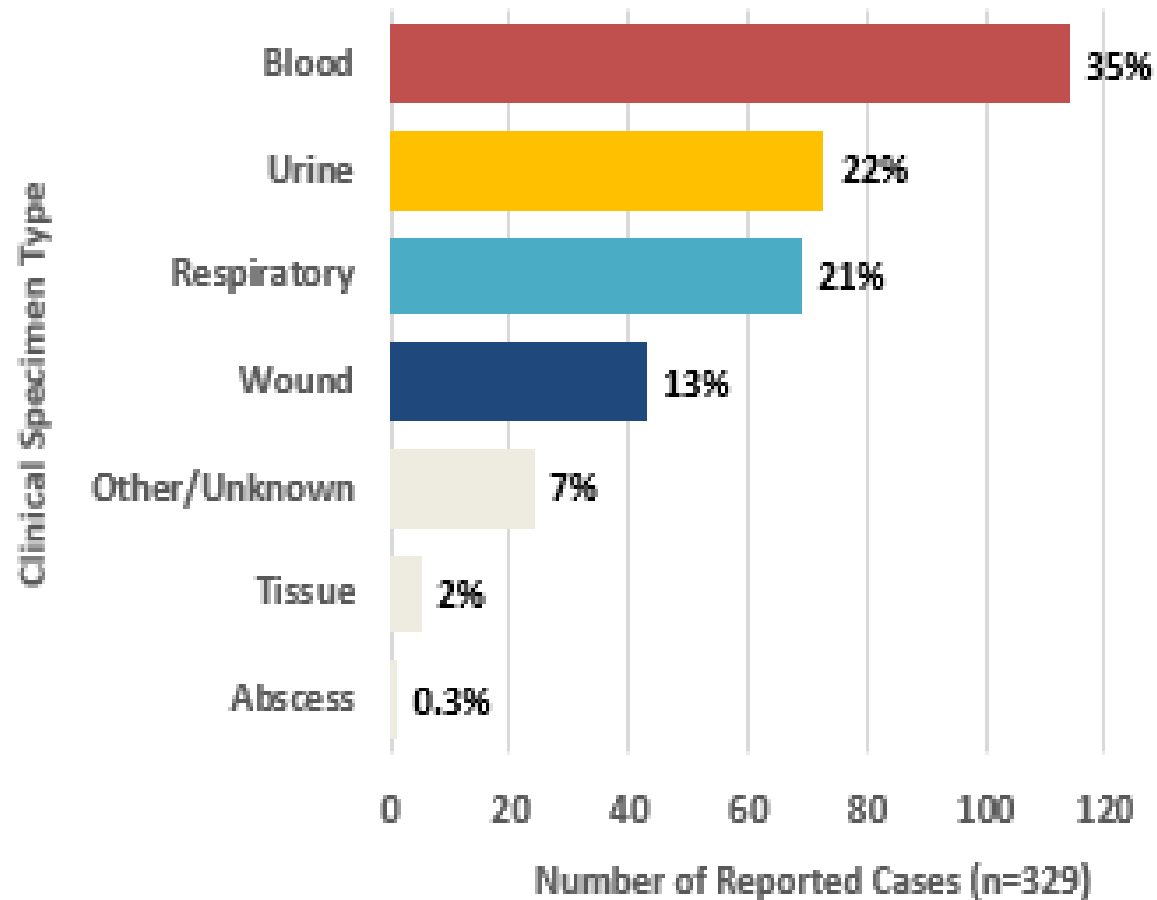
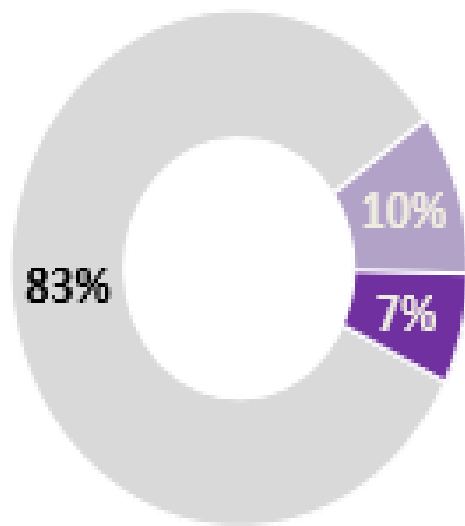


LHJ=local health jurisdiction

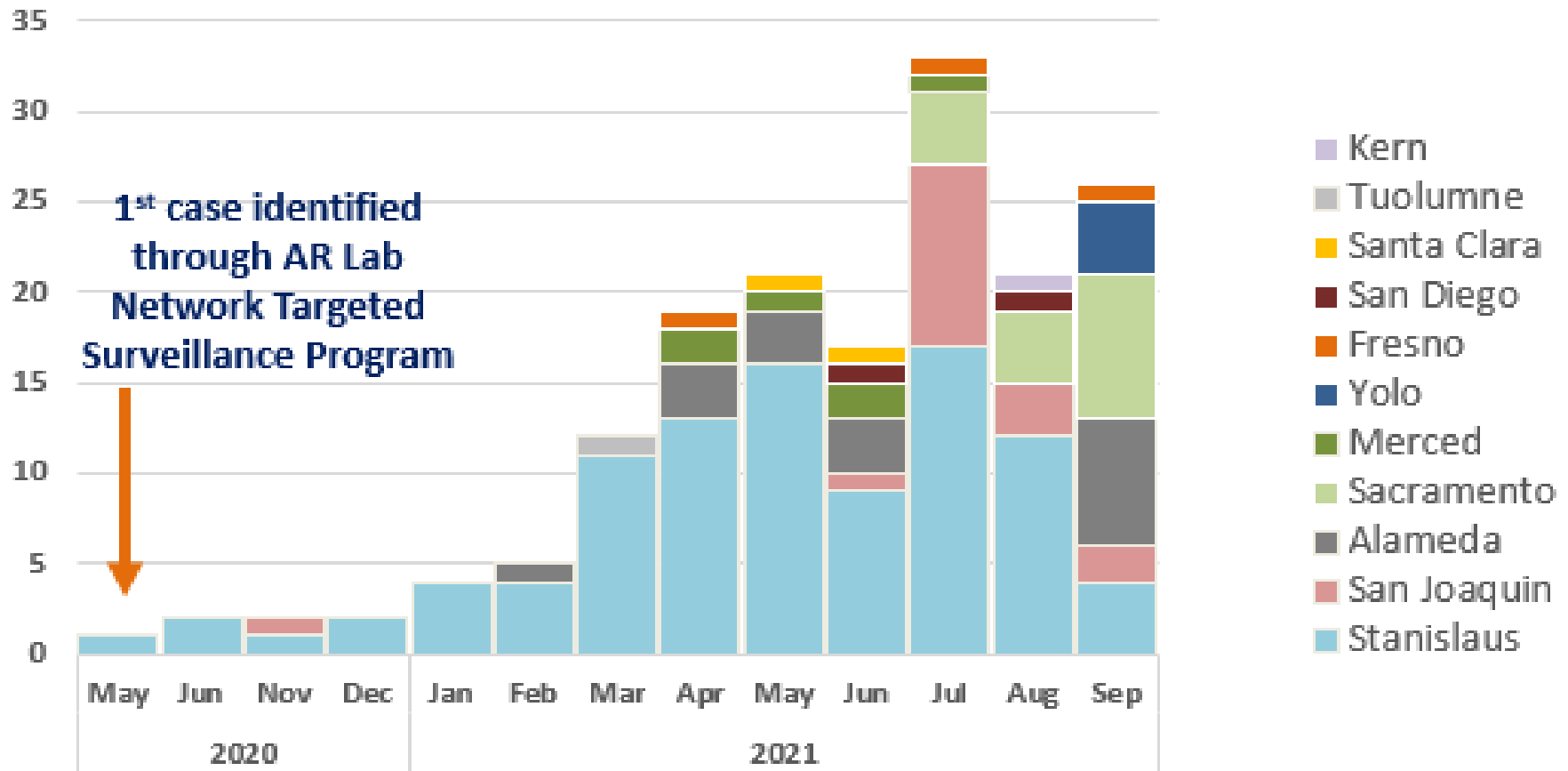


## *C. auris* Screening vs. Clinical Cases

- Screening
- Screening then Clinical
- Clinical

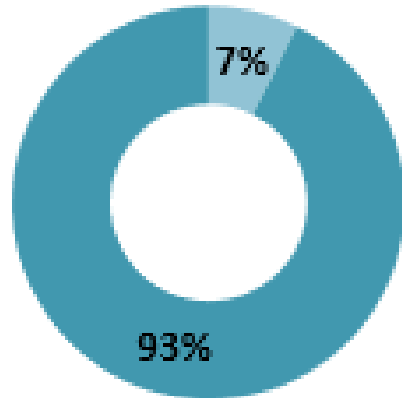


# NDM CRAB epi curve by LHJ through Sep 2021 (N=165)



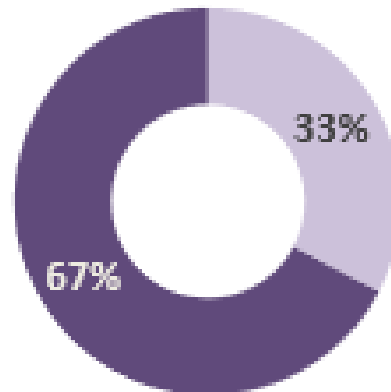
# NDM CRAB

Pan-Nonsusceptible (NS)



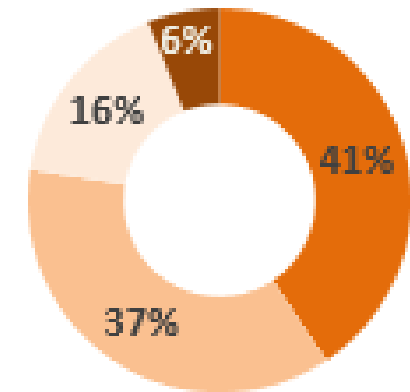
■ Non-Pan-NS ■ Pan-NS

Case Type



■ Clinical ■ Screening

Facility Type



■ SNF ■ ACH ■ vSNF ■ LTACH

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ACH=acute care hospital; LTACH=long-term ACH; SNF=skilled nursing facility;  
vSNF=ventilator-equipped SNF

# AR Lab Network Targeted Surveillance

- Access to advanced lab testing and resources
  - Free shipping
  - Enables early detection of novel organisms/resistance mechanisms (e.g., *C. auris*, NDM CRAB)
  - CRAB, CRPA, non-*albicans* *Candida*
  - [Targeted surveillance flyer](#) (PDF)  
([www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/CDPH\\_A\\_RLN\\_TargetedSurveillanceDescription\\_052521.pdf](http://www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/CDPH_A_RLN_TargetedSurveillanceDescription_052521.pdf))
  - Contact [HAIProgram@cdph.ca.gov](mailto:HAIProgram@cdph.ca.gov) for more information
- 
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# **National Healthcare Safety Network (NHSN) Data: AR Testing Capacity**



# Laboratory Practices to Identify Antimicrobial Resistant Pathogens

- California acute care hospitals annually complete the NHSN Annual Survey
  - Infection Control Practices
  - Microbiology Methods
  - Antimicrobial Stewardship Policies
- CDC uses information to track hospital characteristics and practices over time

*Infection Control & Hospital Epidemiology* (2018), 0, 1–3  
doi:10.1017/ice.2018.153

## Concise Communication

Hospital microbiology laboratory practices for Enterobacteriaceae: Centers for Disease Control and Prevention National Healthcare Safety Network (NHSN) annual survey, 2015 and 2016

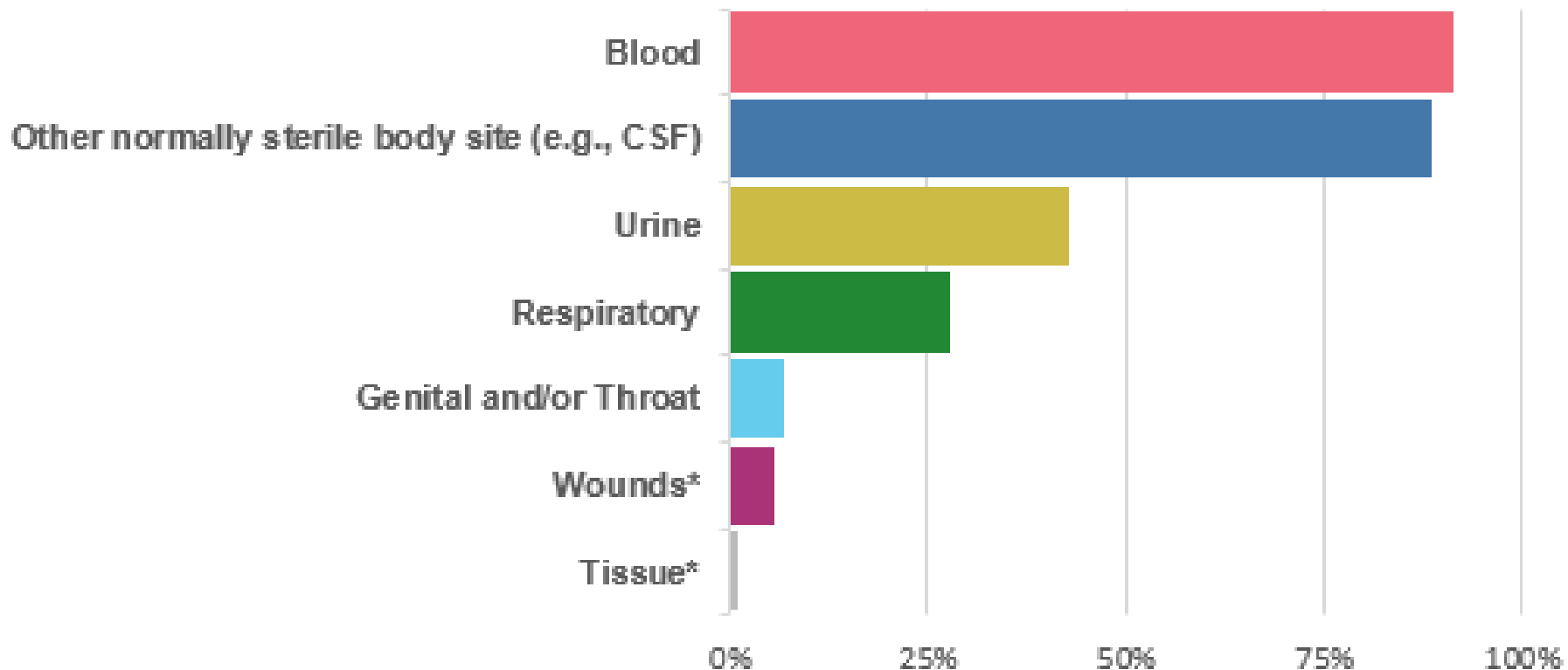
Alicia Shugart MA, Maroya Spalding Walters PhD, ScM, Lindsey M. Weiner MPH, David Lonsway MmedSc and Alexander J. Kallen MD, MPH

Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia



# Candida Species Identification, 2020

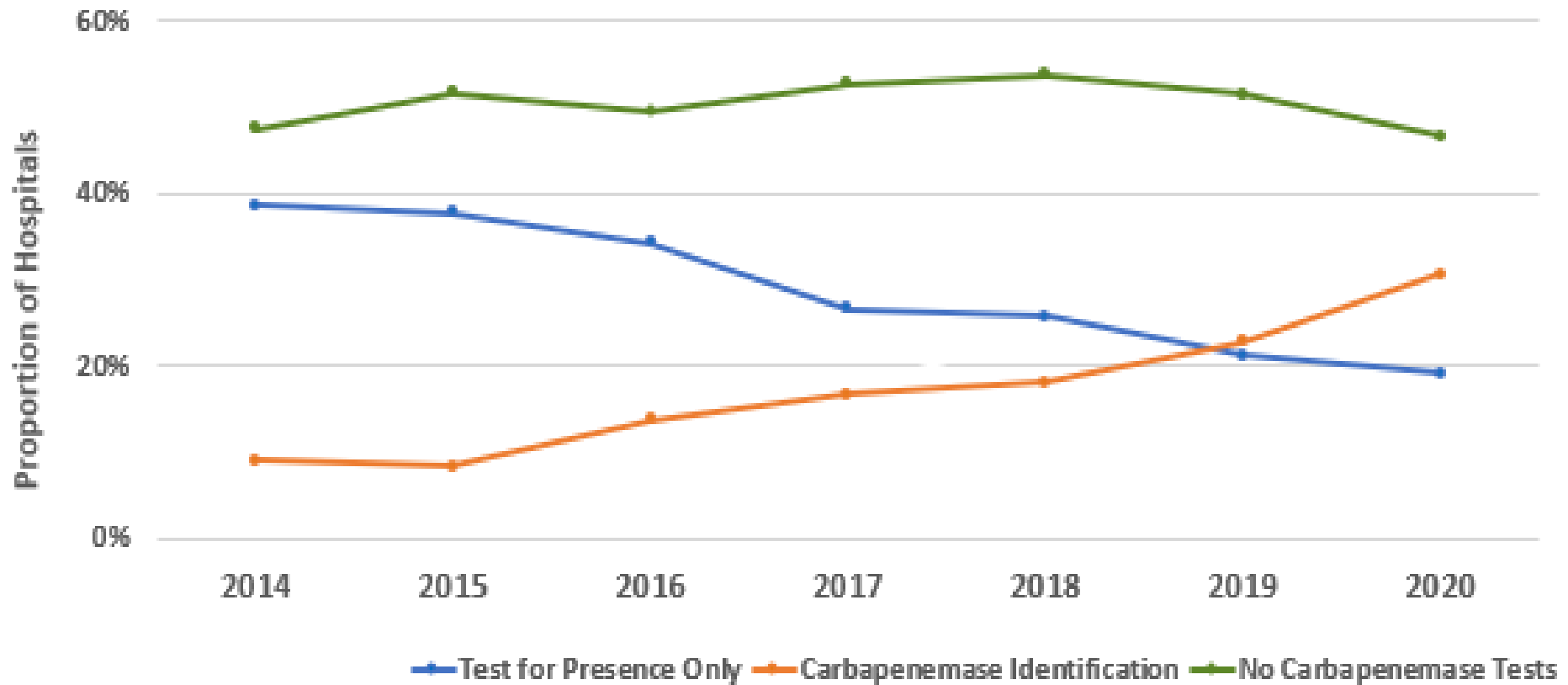
Laboratory Fully Identifies *Candida* species from Specific Body Sites



\*Respondents indicate they speciate *Candida* only for specific wounds or tissue specimens  
[NHSN Annual Survey, 2020](https://www.cdc.gov/nhsn/forms/57.103_pshospsurv_blank.pdf) (PDF)  
([www.cdc.gov/nhsn/forms/57.103\\_pshospsurv\\_blank.pdf](https://www.cdc.gov/nhsn/forms/57.103_pshospsurv_blank.pdf))

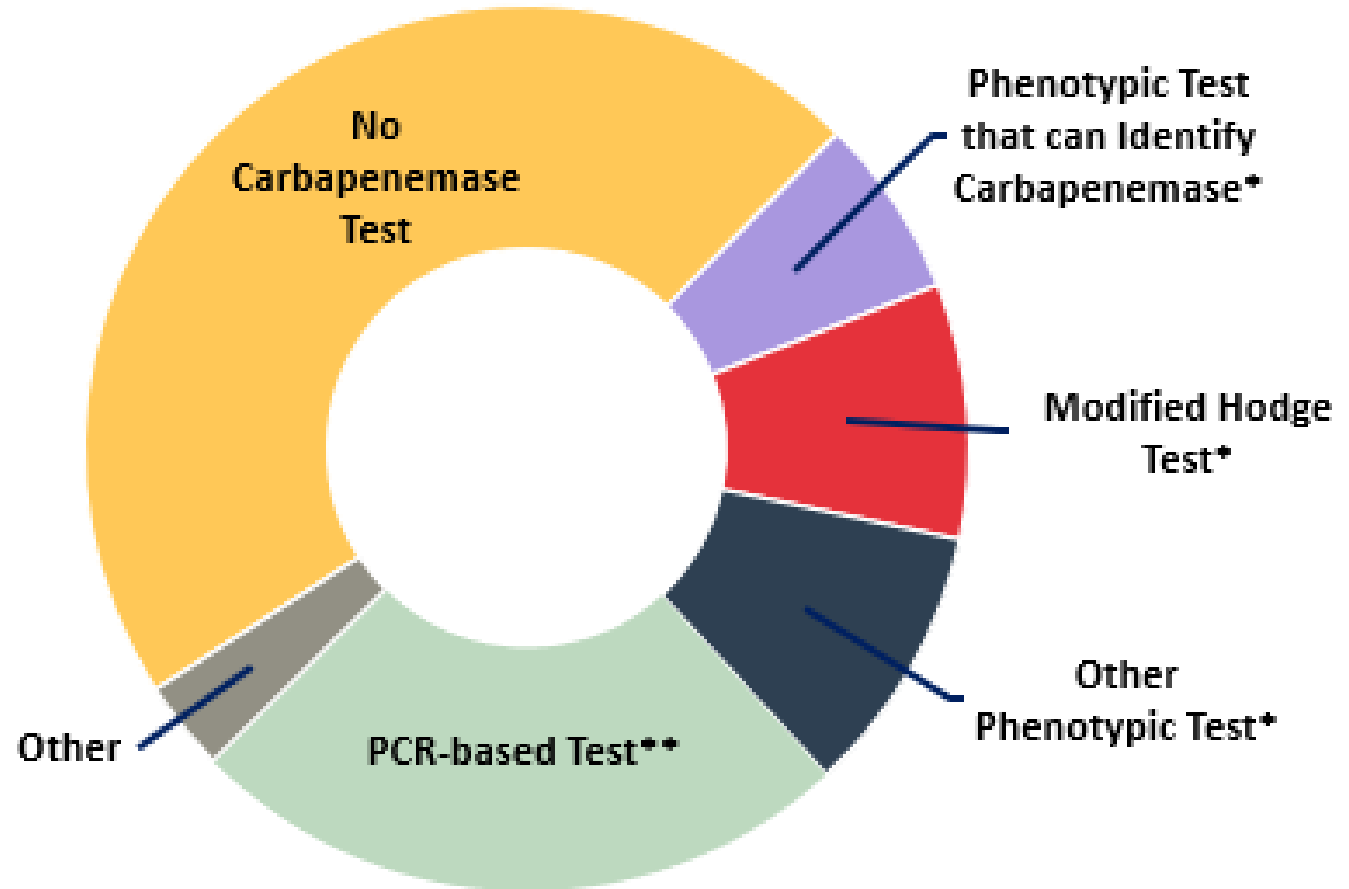
# Type of Carbapenemase Test by Year, 2014 – 2020

## Laboratory Performs a Test for Presence of Carbapenemase





# Access to Carbapenemase Testing Among 365 Short Stay & Long-Term Acute Care Hospitals, 2020



\*Facilities report using a lab with phenotypic test only

\*\*Facilities report using a lab with PCR and/or a commercial molecular test

# Types of Reported Carbapenemase Tests, 2014 – 2020

Carbapenemase Test	Examples	Identify Carbapenemase Type or Class
PCR-based	Lab-developed PCR Commercial Tests (e.g., Cepheid, BioFire array, Verigene®)	✓
Phenotypic	Modified Hodge Test* E Test CIM/mCIM Carba NP Rapid CARB Blue	✗
Phenotypic + Carbapenemase Identification	BD Phoenix CPO detect NG-Test® CARBA 5 MBL Screen	✓
Other	Send Out, Screens	

\*Not recommended



# Title 17 Proposed Changes



# Carbapenemase-Producing Organisms (CPO)

Replace carbapenemase-producing (CP)-CRE with CPO reportable condition

- **Simplify reporting** by excluding carbapenem-resistant organisms not tested for carbapenemase
  - **Expand to include other epi-relevant CPO** (e.g., *Acinetobacter*, *Pseudomonas*, *Citrobacter*)
  - Keep as **lab-reportable** within 1 working day with **no submission, susceptibility testing requirements**
  - **CSTE/CDC** currently revising CP-CRE position statement
  - Will not override local reporting/submission requirements
- 
-

## *Candida auris*

- Nationally notifiable to CDC; reportable in some counties
- **Laboratories** report detection of *C. auris* from any body site using either a culture or a non-culture-based test (e.g., PCR) within 1 working day.
  - Submit isolates from sterile sites within 10 working days
  - ~8% of *C. auris* reported to CDPH is from a sterile site
- **Healthcare providers** submit a report including:
  - Patient demographic factors
  - Facility & lab information
  - Epi information (e.g., risk factors)

## Key Messages

- Identify *Candida* isolates to the species level
- Perform or obtain carbapenemase testing on all CRE, CRAB, and CRPA\*
  - Identification of specific carbapenemase is preferred
- Public health resources are available!
  - **Regional Lab:** Targeted surveillance (CRPA, CRAB, non-*albicans Candida*)
  - **MDL:** CRE, CRPA, all pan-resistant CRO, *Candida* isolates
  - **Local public health labs:** varies
  - **HAI:** AR containment and response support

# Resources

- [CDPH Antimicrobial Resistance Resources landing webpage](http://www.cdph.ca.gov/Programs/CHCQ/HAI/Pages/AntimicrobialResistanceLandingPage.aspx)  
(www.cdph.ca.gov/Programs/CHCQ/HAI/Pages/AntimicrobialResistanceLandingPage.aspx)
- [CDPH CPO Webpage](http://www.cdph.ca.gov/Programs/CHCQ/HAI/Pages/CRE_InfectionPreventionStrategies.aspx)  
(www.cdph.ca.gov/Programs/CHCQ/HAI/Pages/CRE\_InfectionPreventionStrategies.aspx)
- [CDPH \*C. auris\* Webpage](http://www.cdph.ca.gov/Programs/CHCQ/HAI/Pages/Candida-auris.aspx)  
(www.cdph.ca.gov/Programs/CHCQ/HAI/Pages/Candida-auris.aspx)
- [CDPH Algorithm for Prioritizing Carbapenemase Testing](#) (PDF)  
(www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/CP\_Testing\_Prioritization\_Algorithm\_Oct2020.pdf)
- [CDPH \*C. auris\* and CPO Screening Decision Tree](#) (PDF)  
(www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/Tier2\_Pathogen\_Screening\_Decision\_Tree\_Oct2020.pdf)
- [AR Lab Network Targeted Surveillance Program](#) (PDF)  
(www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/CDPH\_ARLN\_TargetedSurveillanceDescription\_052521.pdf)
- [MDL Submission Instructions and Forms](http://www.cdph.ca.gov/Programs/CID/DCDC/Pages/MDLSubmissionInstructionsandForms.aspx)  
(www.cdph.ca.gov/Programs/CID/DCDC/Pages/MDLSubmissionInstructionsandForms.aspx)
- [MDL Carbapenemase Testing Services FAQ](#) (PDF)  
(www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/MDL\_Expanded-Carbapenemase\_Testing\_FAQ-Sheet.pdf)

# Questions?

## For more information, contact:

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